

Assignment 2

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Libraries

Load dataset

Data context

This dataset contains information about customers. Demographic data,

Data exploration

```
dim(df)
```

```
## [1] 7043 21
```

```
names(df)
```

```
## [1] "customerID"      "gender"           "SeniorCitizen"    "Partner"
## [5] "Dependents"      "tenure"           "PhoneService"     "MultipleLines"
## [9] "InternetService" "OnlineSecurity"   "OnlineBackup"     "DeviceProtection"
## [13] "TechSupport"     "StreamingTV"      "StreamingMovies"  "Contract"
## [17] "PaperlessBilling" "PaymentMethod"    "MonthlyCharges"   "TotalCharges"
## [21] "Churn"
```

```
#str(df)
```

```
#summary(df)
```

We only have NA values in *TotalCharges*.

```
summary(is.na(df))
```

```
## customerID      gender      SeniorCitizen      Partner
## Mode :logical   Mode :logical   Mode :logical   Mode :logical
## FALSE:7043      FALSE:7043      FALSE:7043      FALSE:7043
##
## Dependents      tenure      PhoneService    MultipleLines
## Mode :logical   Mode :logical   Mode :logical   Mode :logical
## FALSE:7043      FALSE:7043      FALSE:7043      FALSE:7043
##
## InternetService OnlineSecurity OnlineBackup    DeviceProtection
## Mode :logical   Mode :logical   Mode :logical   Mode :logical
## FALSE:7043      FALSE:7043      FALSE:7043      FALSE:7043
##
## TechSupport     StreamingTV    StreamingMovies  Contract
```

```
## Mode :logical      Mode :logical      Mode :logical      Mode :logical
## FALSE:7043         FALSE:7043         FALSE:7043         FALSE:7043
##
## PaperlessBilling PaymentMethod      MonthlyCharges      TotalCharges
## Mode :logical      Mode :logical      Mode :logical      Mode :logical
## FALSE:7043         FALSE:7043         FALSE:7043         FALSE:7032
##                                     TRUE :11
##      Churn
## Mode :logical
## FALSE:7043
##
```

Variable Description

In total, we have 21 variables related to demographic, services, and accountant data. One is the ID, three are numerical variables, and 17 are categorical (? binary) variables. We will conduct a descriptive analysis and a data quality report for each variable, considering aspects such as the number of missing values, errors, and the distribution or balance of the variable...

1. customerID

Demographic data

2. gender Is a binary variable (female/male).

```
sum(is.na(df$gender))
```

```
## [1] 0
```

```
table(df$gender)
```

```
##
```

```
## Female      Male
```

```
##    3488    3555
```

3. SeniorCitizen It is a binary variable. Levels: 1(=yes)/0(=no).

```
sum(is.na(df$SeniorCitizen))
```

```
## [1] 0
```

```
table(df$SeniorCitizen)
```

```
##
```

```
##      0      1
```

```
## 5901 1142
```

4. Partner It is a binary variable. Levels: Yes/No.

```
sum(is.na(df$Partner))
```

```
## [1] 0
```

```
table(df$Partner)
```

```
##
```

```
##      No      Yes
```

```
## 3641 3402
```

5. Dependents It is a binary variable. Levels: Yes/No.

```
sum(is.na(df$Dependents))
```

```
## [1] 0
```

```
table(df$Dependents)
```

```
##
```

```
## No Yes
```

```
## 4933 2110
```

```
#plots
```

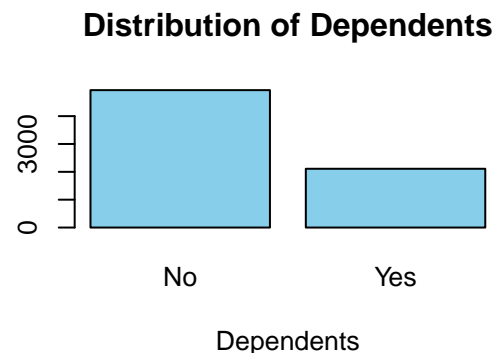
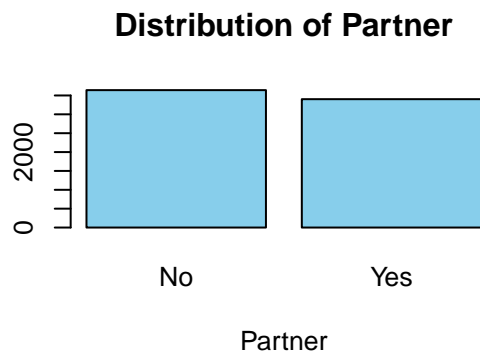
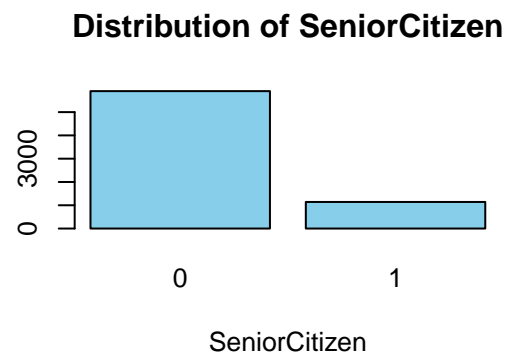
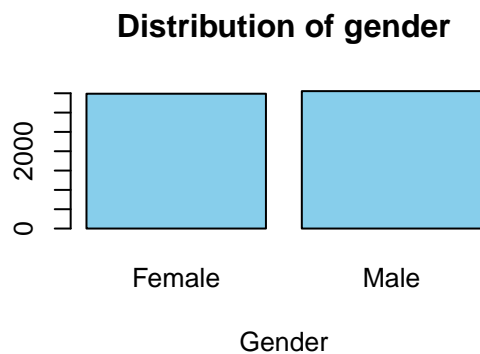
```
par(mfrow = c(2, 2))
```

```
barplot(table(df$gender), main = "Distribution of gender", xlab = "Gender", col = "skyblue")
```

```
barplot(table(df$SeniorCitizen), main = "Distribution of SeniorCitizen", xlab = "SeniorCitizen", col = "skyblue")
```

```
barplot(table(df$Partner), main = "Distribution of Partner", xlab = "Partner", col = "skyblue")
```

```
barplot(table(df$Dependents), main = "Distribution of Dependents", xlab = "Dependents", col = "skyblue")
```



Services of the costumer data

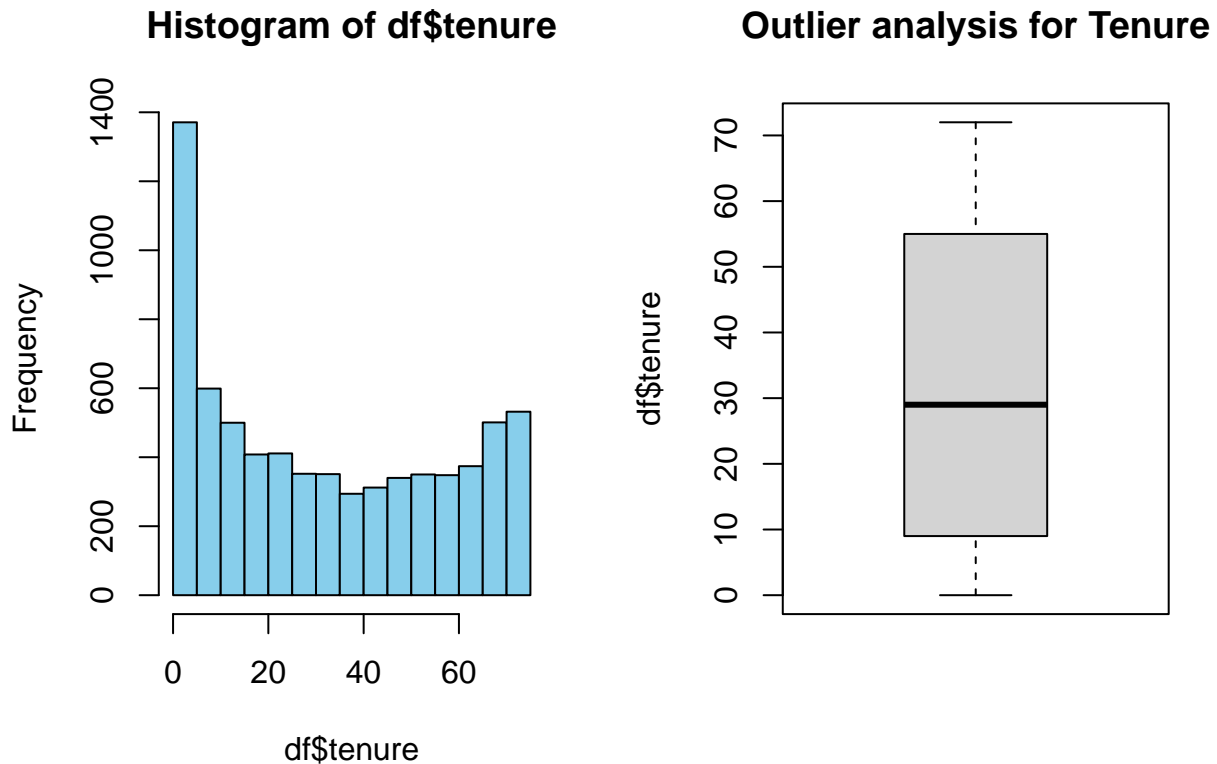
Services that each customer has signed up for:

6. tenure It is a numerical variable that indicates the duration, in months, that the customer has stayed with the company. We shall explore the statistics of the variable and look for the *outliers*

```
summary(df$tenure)
```

```
##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   \n##      0.00    9.00   29.00   32.37   55.00   72.00
```

```
par(mfrow = c(1, 2))
hist(df$tenure, breaks=20, col="skyblue")
Boxplot(df$tenure, main="Outlier analysis for Tenure")
```



```
par(mfrow = c(1, 1))
sm_t <- summary(df$tenure)
iqr_t <- sm_t["3rd Qu."] - sm_t["1st Qu."]
# Mild Outliers
mild_ub_t <- sm_t["3rd Qu."] + 1.5 * iqr_t
mild_lb_t <- sm_t["1st Qu."] - 1.5 * iqr_t
length(which(df$tenure > mild_ub_t | df$tenure < mild_lb_t)) # number of mild outliers

## [1] 0

# Severe Outliers
severe_ub_t <- sm_t["3rd Qu."] + 3 * iqr_t
severe_lb_t <- sm_t["1st Qu."] - 3 * iqr_t
length(which(df$tenure > severe_ub_t | df$tenure < severe_lb_t)) # number of severe outliers

## [1] 0
```

There are *no mild nor severe outliers* in Tenure.

7. PhoneService It is a binary variable. Levels: Yes/No.

```
sum(is.na(df$PhoneService))
```

```
## [1] 0
```

```
table(df$PhoneService)
```

```
##
```

```
## No Yes
## 682 6361
```

8. MultipleLines Categorical variable with 3 levels, No/No phone service/Yes.

```
sum(is.na(df$MultipleLines))
```

```
## [1] 0
```

```
table(df$MultipleLines)
```

```
##
##          No No phone service          Yes
##          3390          682          2971
```

Check inconsistencies: - Cannot happen that a costumer has not phoneservice and multiplelines.

```
subset(df, MultipleLines == "Yes" & PhoneService == "No")
```

```
## [1] customerID      gender      SeniorCitizen  Partner
## [5] Dependents      tenure      PhoneService    MultipleLines
## [9] InternetService  OnlineSecurity OnlineBackup    DeviceProtection
## [13] TechSupport      StreamingTV    StreamingMovies  Contract
## [17] PaperlessBilling PaymentMethod  MonthlyCharges  TotalCharges
## [21] Churn
## <0 rows> (or 0-length row.names)
```

9. InternetService Categorical variable with 3 levels: DSL/Fiber optic/No.

```
table(df$InternetService)
```

```
##
##          DSL Fiber optic          No
##          2421          3096          1526
```

10. OnlineSecurity Categorical variable with 3 levels: No/No internet service/Yes

```
table(df$OnlineSecurity)
```

```
##
##          No No internet service          Yes
##          3498          1526          2019
```

```
#plots:
```

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

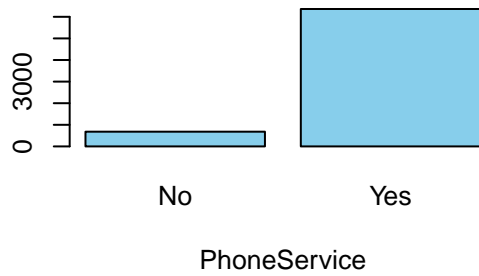
```
barplot(table(df$PhoneService), main = "Distribution of PhoneService", xlab = "PhoneService", col = "skyblue")
```

```
barplot(table(df$MultipleLines), main = "Distribution of MultipleLines", xlab = "MultipleLines", col = "skyblue")
```

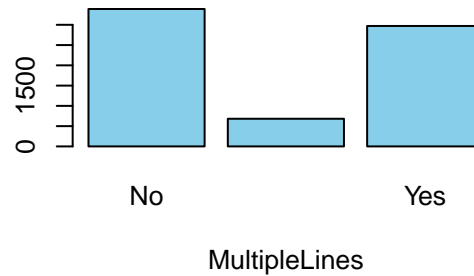
```
barplot(table(df$InternetService), main = "Distribution of InternetService", xlab = "InternetService", col = "skyblue")
```

```
barplot(table(df$OnlineSecurity), main = "Distribution of OnlineSecurity", xlab = "OnlineSecurity", col = "skyblue")
```

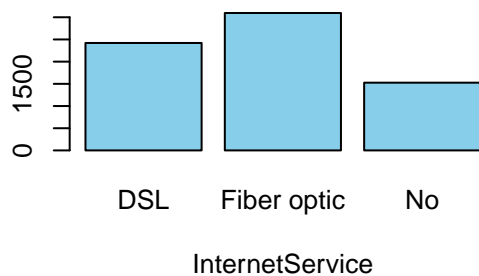
Distribution of PhoneService



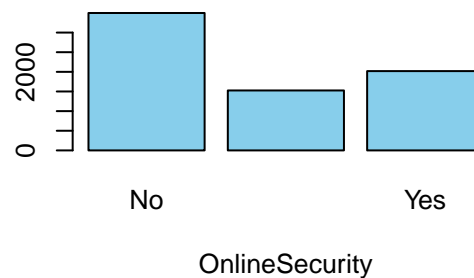
Distribution of MultipleLines



Distribution of InternetService



Distribution of OnlineSecurity



Check consistency

```
sum(df$InternetService == "No")
```

```
## [1] 1526
```

```
sum(df$OnlineSecurity == "No internet service")
```

```
## [1] 1526
```

```
nrow(subset(df, InternetService == "No" & OnlineSecurity == "No internet service"))
```

```
## [1] 1526
```

11. OnlineBackup Categorical variable with 3 levels: No/No internet service/Yes

```
table(df$OnlineBackup)
```

```
##
```

```
##           No No internet service           Yes
```

```
##           3088             1526           2429
```

```
# Check consistency
```

```
sum(df$OnlineBackup == "No internet service") #1526
```

```
## [1] 1526
```

```
sum(df$OnlineSecurity == "No internet service") #1526
```

```
## [1] 1526
```

12. DeviceProtection Categorical variable with 3 levels: No/No internet service/Yes

```
table(df$DeviceProtection)
```

```
##  
##           No No internet service           Yes  
##           3095           1526           2422
```

```
# Check consistency
```

```
sum(df$OnlineSecurity == "No internet service") #1526
```

```
## [1] 1526
```

```
sum(df$DeviceProtection == "No internet service") #1526
```

```
## [1] 1526
```

13. TechSupport Categorical variable with 3 levels: No/No internet service/Yes

```
table(df$TechSupport)
```

```
##  
##           No No internet service           Yes  
##           3473           1526           2044
```

```
#Check consistency
```

```
sum(df$DeviceProtection == "No internet service") #1526
```

```
## [1] 1526
```

```
sum(df$TechSupport == "No internet service") #1526
```

```
## [1] 1526
```

14. StreamingTV Categorical variable with 3 levels: No/No internet service/Yes

```
table(df$StreamingTV)
```

```
##  
##           No No internet service           Yes  
##           2810           1526           2707
```

```
#Check consistency
```

```
sum(df$TechSupport == "No internet service") #1526
```

```
## [1] 1526
```

```
sum(df$StreamingTV == "No internet service") #1526
```

```
## [1] 1526
```

15. StreamingMovies Categorical variable with 3 levels: No/No internet service/Yes

```
table(df$StreamingMovies)
```

```
##  
##           No No internet service           Yes  
##           2785           1526           2732
```

```
#Check consistency
```

```
sum(df$StreamingTV == "No internet service") #1526
```

```
## [1] 1526
```

```
sum(df$StreamingMovies == "No internet service") #1526
```

```
## [1] 1526
```

```
#plots:
```

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

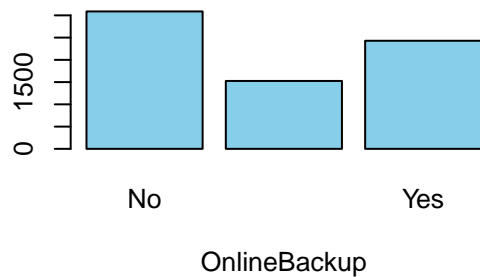
```
barplot(table(df$OnlineBackup), main = "Distribution of OnlineBackup",xlab = "OnlineBackup",col = "skyblue")
```

```
barplot(table(df$DeviceProtection), main = "Distribution of DeviceProtection",xlab = "DeviceProtection",col = "skyblue")
```

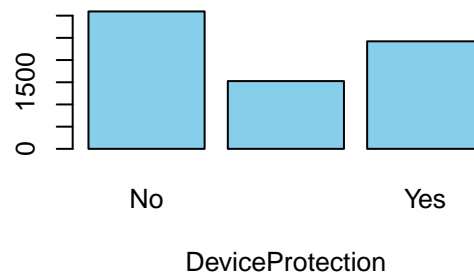
```
barplot(table(df$TechSupport), main = "Distribution of TechSupport",xlab = "TechSupport",col = "skyblue")
```

```
barplot(table(df$StreamingTV), main = "Distribution of StreamingTV",xlab = "StreamingTV",col = "skyblue")
```

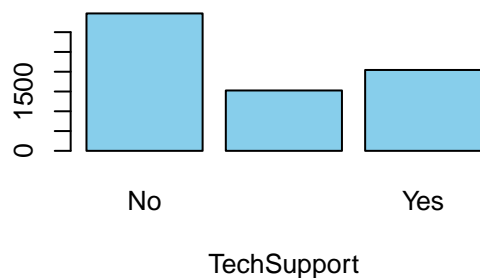
Distribution of OnlineBackup



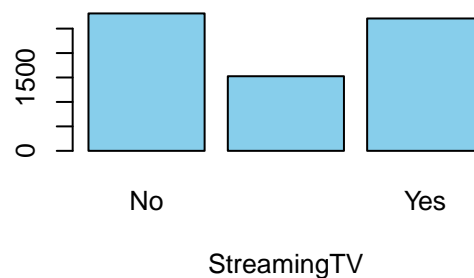
Distribution of DeviceProtection



Distribution of TechSupport

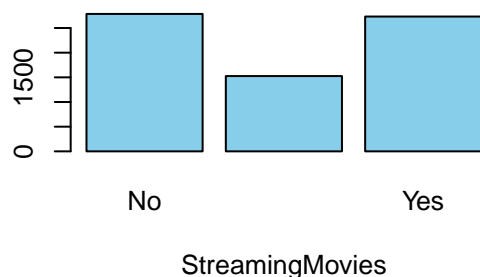


Distribution of StreamingTV



```
barplot(table(df$StreamingMovies), main = "Distribution of StreamingMovies",xlab = "StreamingMovies",col = "skyblue")
```

Distribution of StreamingMovies



Customer account data

16. Contract Categorical variable with 3 levels: Month-to-month/One year/Two year


```
table(df$Contract)
```

```
##
## Month-to-month      One year      Two year
##           3875           1473           1695
```

17. PaperlessBilling It is a binary variable. Levels: No/Yes

```
table(df$PaperlessBilling)
```

```
##
## No  Yes
## 2872 4171
```

18. PaymentMethod Categorical variable with 4 levels: Bank transfer (automatic)/Credit card (automatic)/Electronic check/Mailed check

```
table(df$PaymentMethod)
```

```
##
## Bank transfer (automatic)  Credit card (automatic)      Electronic check
##                1544                1522                2365
##           Mailed check
##                1612
```

```
#plots
```

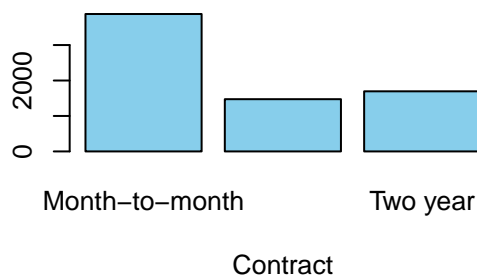
```
par(mfrow = c(2, 2))
```

```
barplot(table(df$Contract), main = "Distribution of Contract",xlab = "Contract",col = "skyblue")
```

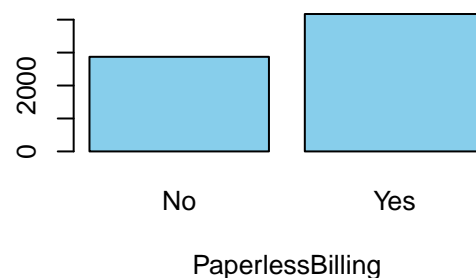
```
barplot(table(df$PaperlessBilling), main = "Distribution of PaperlessBilling",xlab = "PaperlessBilling"
```

```
barplot(table(df$PaymentMethod), main = "Distribution of PaymentMethod",xlab = "PaymentMethod",col = "skyblue")
```

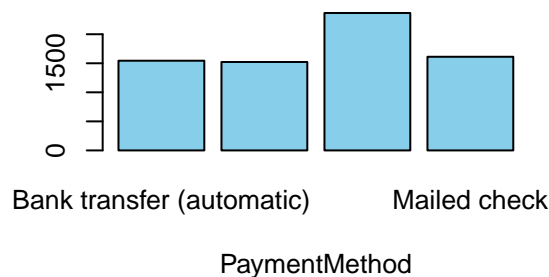
Distribution of Contract



Distribution of PaperlessBilling



Distribution of PaymentMethod



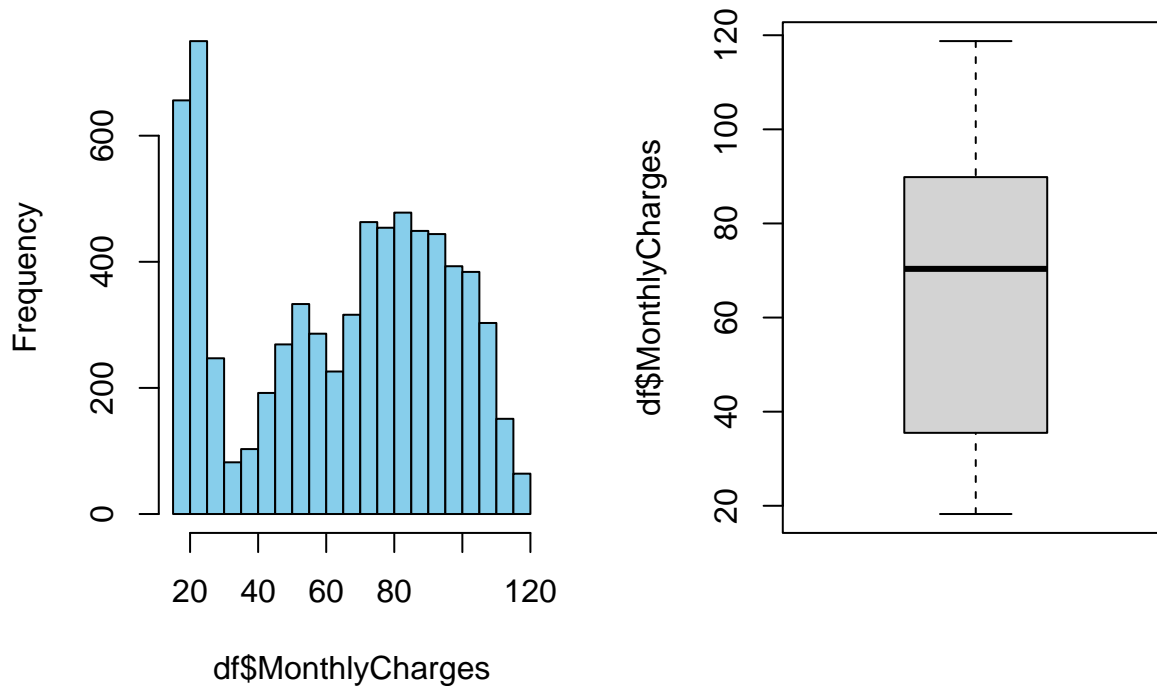
19. MonthlyCharges It is a numerical variable.

```
summary(df$MonthlyCharges)
```

```
##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    18.25  35.50   70.35   64.76   89.85  118.75
```

```
par(mfrow = c(1,2))
hist(df$MonthlyCharges,breaks=20,col="skyblue")
Boxplot(df$MonthlyCharges, main="Outlier analysis for MonthlyCharges")
```

Histogram of df\$MonthlyCharge Outlier analysis for MonthlyCharg



Let's look for *outliers*.

```
sm <- summary(df$MonthlyCharges)
iqr <- sm["3rd Qu."] - sm["1st Qu."]
# Mild Outliers
mild_ub <- sm["3rd Qu."] + 1.5 * iqr
mild_lb <- sm["1st Qu."] - 1.5 * iqr
length(which(df$MonthlyCharges > mild_ub | df$MonthlyCharges < mild_lb)) # number of mild outliers

## [1] 0

# Severe Outliers
severe_ub <- sm["3rd Qu."] + 3 * iqr
severe_lb <- sm["1st Qu."] - 3 * iqr
length(which(df$MonthlyCharges > severe_ub | df$MonthlyCharges < severe_lb)) # number of severe outliers

## [1] 0
```

There are no mild nor severe outliers in MonthlyCharges.

20. TotalCharges (numeric) It is a numerical variable.

```
summary(df$TotalCharges)
```

```
##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.     NA's
##      18.8   401.4  1397.5  2283.3  3794.7  8684.8      11
```

```
sum(is.na(df$TotalCharges))
```

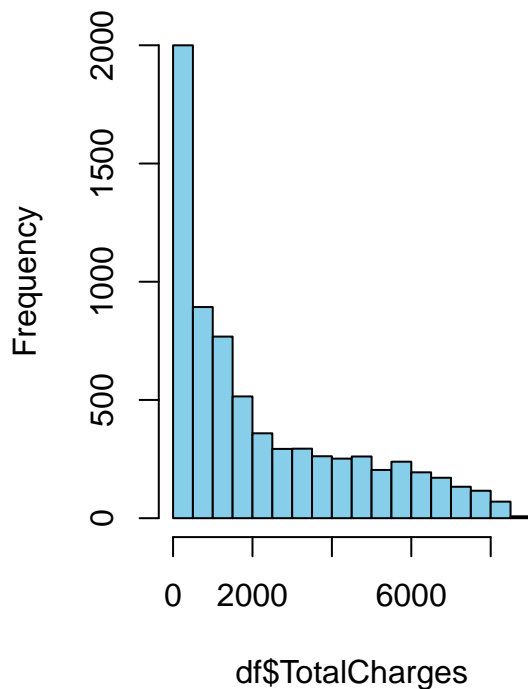
```
## [1] 11
```

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

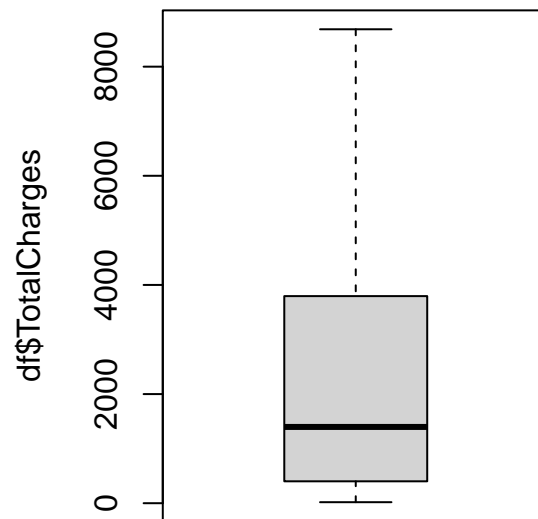
```
hist(df$TotalCharges,breaks=20,col="skyblue")
```

```
Boxplot(df$TotalCharges, main="Outlier analysis for TotalCharges")
```

Histogram of df\$TotalCharges



Outlier analysis for TotalCharges



Let's look for *outliers*.

```
sm <- summary(df$TotalCharges)
```

```
iqr <- sm["3rd Qu."] - sm["1st Qu."]
```

```
# Mild Outliers
```

```
mild_ub <- sm["3rd Qu."] + 1.5 * iqr
```

```
mild_lb <- sm["1st Qu."] - 1.5 * iqr
```

```
length(which(df$TotalCharges > mild_ub | df$TotalCharges < mild_lb)) # number of mild outliers
```

```
## [1] 0
```

```
# Severe Outliers
```

```
severe_ub <- sm["3rd Qu."] + 3 * iqr
```

```
severe_lb <- sm["1st Qu."] - 3 * iqr
```

```
length(which(df$TotalCharges > severe_ub | df$TotalCharges < severe_lb)) # number of severe outliers
```

```
## [1] 0
```

There are no mild nor severe outliers.

Target:

21. Churn It is the target variable. It is binary, describes whether the customer churned or not (Yes or No). ?explicar que es churn una mica.

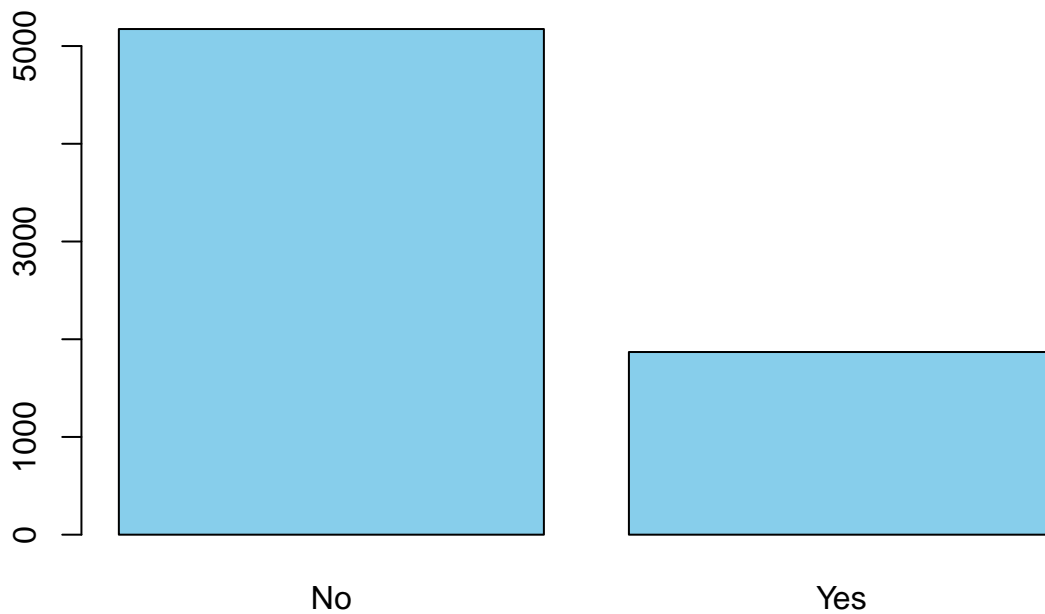
```
table(df$Churn)
```

```
##  
##   No   Yes  
## 5174 1869
```

```
prop.table(table(df$Churn))
```

```
##  
##      No      Yes  
## 0.7346301 0.2653699
```

```
barplot(table(df$Churn), col="skyblue")
```



Data preprocessing

Recode variables into correct type

We shall reconvert the type of certain variables that are encoded with wrong type. First, we convert the character variables (except the ID) into factors.

```
char_cols <- which(sapply(df, is.character))  
df[, char_cols[-1]] <- lapply(df[, char_cols[-1]], as.factor)
```

Also, we convert the numerical variable SeniorCitizen into a factor.

```
df$SeniorCitizen <- factor(df$SeniorCitizen)
```

Data imputation

```
summary(is.na(df))
```

```
##  customerID      gender  SeniorCitizen  Partner
```

```
## Mode :logical    Mode :logical    Mode :logical    Mode :logical
## FALSE:7043      FALSE:7043      FALSE:7043      FALSE:7043
##
## Dependents      tenure          PhoneService     MultipleLines
## Mode :logical    Mode :logical    Mode :logical    Mode :logical
## FALSE:7043      FALSE:7043      FALSE:7043      FALSE:7043
##
## InternetService OnlineSecurity OnlineBackup     DeviceProtection
## Mode :logical    Mode :logical    Mode :logical    Mode :logical
## FALSE:7043      FALSE:7043      FALSE:7043      FALSE:7043
##
## TechSupport     StreamingTV      StreamingMovies   Contract
## Mode :logical    Mode :logical    Mode :logical    Mode :logical
## FALSE:7043      FALSE:7043      FALSE:7043      FALSE:7043
##
## PaperlessBilling PaymentMethod    MonthlyCharges    TotalCharges
## Mode :logical    Mode :logical    Mode :logical    Mode :logical
## FALSE:7043      FALSE:7043      FALSE:7043      FALSE:7032
##                                     TRUE :11
## Churn
## Mode :logical
## FALSE:7043
##
```

Only the variable TotalCharges has NA's.

```
#df[is.na(df$TotalCharges), ]
#df[df$tenure==0,]
#df[df$TotalCharges==0, ]
#summary(df$TotalCharges)
```

The missing data corresponds to the individuals that have not payed yet the charges of the current month, we can guess that are new clients of the company.

Duplicate values: no

```
dim(df)
```

```
## [1] 7043    21
```

```
length(unique(df$customerID))
```

```
## [1] 7043
```

El significat d'aquestos NA son que l'individu encara no se li ha cobrat el charges ja que no ha arribat a final de més. Una possible solució seria que la variable totalcharges prengui el valor de monthlycharges.

Sugerim quan tenure==0 eliminem les observacions enlloc d'imputar-les ja que representen un 0.1% de les dades. NO ELIMINEM FIQUEM 0

```
l1 <- which(is.na(df$TotalCharges))
df[l1,"TotalCharges"] <- 0
summary(is.na(df$TotalCharges))
```

```
## Mode FALSE
## logical 7043
```

Això crec que és un pas que està descrit al pdf però no sé perquè s'ha de fer

Create variable adding the total number missing values, outliers and errors. Describe these variables, to

which other variables exist higher associations. Compute the correlation with all other variables. Rank these variables according the correlation Compute for every group of individuals (group of age, size of town, singles, married, ...) the mean of missing/outliers/errors values. Rank the groups according the computed mean.

Correlation between numericals

(no cal)

```
num_cols <- which(sapply(df, is.numeric))
cor(df[,c(6,19,20)])
```

```
##                tenure MonthlyCharges TotalCharges
## tenure          1.0000000      0.2478999      0.8261784
## MonthlyCharges  0.2478999      1.0000000      0.6511738
## TotalCharges    0.8261784      0.6511738      1.0000000
```

Correlation between categorical

The categorical variables MultipleLines and PhoneService are 100% correlated.

```
contingency_table<-table(df$MultipleLines,df$PhoneService)
sqrt(chisq.test(contingency_table)$statistic / (sum(contingency_table) * (min(dim(contingency_table)) - 1)))

## X-squared
##          1
```

Profiling

```
res.cat=catdes(df, 21)
res.cat$test.chi2
```

```
##                p.value df
## Contract        5.863038e-258 2
## OnlineSecurity   2.661150e-185 2
## TechSupport      1.443084e-180 2
## InternetService  9.571788e-160 2
## PaymentMethod    3.682355e-140 3
## OnlineBackup     2.079759e-131 2
## DeviceProtection 5.505219e-122 2
## StreamingMovies  2.667757e-82 2
## StreamingTV       5.528994e-82 2
## PaperlessBilling 2.614597e-58 1
## Dependents        3.276083e-43 1
## SeniorCitizen     9.477904e-37 1
## Partner          1.519037e-36 1
## MultipleLines     3.464383e-03 2
```

```
head(res.cat$category)
```

```
## $No
##                Cla/Mod Mod/Cla  Global
## Contract=Two year      97.16814 31.83224 24.06645
## StreamingMovies=No internet service 92.59502 27.30963 21.66690
## StreamingTV=No internet service    92.59502 27.30963 21.66690
## TechSupport=No internet service    92.59502 27.30963 21.66690
## DeviceProtection=No internet service 92.59502 27.30963 21.66690
## OnlineBackup=No internet service    92.59502 27.30963 21.66690
```

## OnlineSecurity=No internet service	92.59502	27.30963	21.66690
## InternetService=No	92.59502	27.30963	21.66690
## PaperlessBilling=No	83.66992	46.44376	40.77808
## Contract=One year	88.73048	25.26092	20.91438
## OnlineSecurity=Yes	85.38881	33.32045	28.66676
## TechSupport=Yes	84.83366	33.51372	29.02172
## Dependents=Yes	84.54976	34.48009	29.95882
## Partner=Yes	80.33510	52.82180	48.30328
## SeniorCitizen=0	76.39383	87.12795	83.78532
## PaymentMethod=Credit card (automatic)	84.75690	24.93235	21.61011
## InternetService=DSL	81.04089	37.92037	34.37456
## PaymentMethod=Bank transfer (automatic)	83.29016	24.85504	21.92248
## PaymentMethod=Mailed check	80.89330	25.20294	22.88797
## OnlineBackup=Yes	78.46851	36.83804	34.48814
## DeviceProtection=Yes	77.49794	36.27754	34.38875
## MultipleLines=No	74.95575	49.11094	48.13290
## MultipleLines=Yes	71.39010	40.99343	42.18373
## StreamingMovies=Yes	70.05857	36.99266	38.79029
## StreamingTV=Yes	69.92981	36.58678	38.43533
## StreamingTV=No	66.47687	36.10359	39.89777
## StreamingMovies=No	66.31957	35.69772	39.54281
## SeniorCitizen=1	58.31874	12.87205	16.21468
## Partner=No	67.04202	47.17820	51.69672
## Dependents=No	68.72086	65.51991	70.04118
## PaperlessBilling=Yes	66.43491	53.55624	59.22192
## DeviceProtection=No	60.87237	36.41283	43.94434
## OnlineBackup=No	60.07124	35.85234	43.84495
## PaymentMethod=Electronic check	54.71459	25.00966	33.57944
## InternetService=Fiber optic	58.10724	34.77000	43.95854
## TechSupport=No	58.36453	39.17665	49.31137
## OnlineSecurity=No	58.23328	39.36993	49.66634
## Contract=Month-to-month	57.29032	42.90684	55.01917
##	p.value	v.test	
## Contract=Two year	3.588830e-187	29.178937	
## StreamingMovies=No internet service	6.584621e-98	20.999812	
## StreamingTV=No internet service	6.584621e-98	20.999812	
## TechSupport=No internet service	6.584621e-98	20.999812	
## DeviceProtection=No internet service	6.584621e-98	20.999812	
## OnlineBackup=No internet service	6.584621e-98	20.999812	
## OnlineSecurity=No internet service	6.584621e-98	20.999812	
## InternetService=No	6.584621e-98	20.999812	
## PaperlessBilling=No	1.072745e-60	16.435085	
## Contract=One year	3.593041e-57	15.935502	
## OnlineSecurity=Yes	1.606459e-50	14.947938	
## TechSupport=Yes	1.323174e-46	14.334963	
## Dependents=Yes	3.572324e-46	14.265846	
## Partner=Yes	6.170871e-37	12.696658	
## SeniorCitizen=0	3.024931e-34	12.202212	
## PaymentMethod=Credit card (automatic)	6.408166e-32	11.758206	
## InternetService=DSL	2.545367e-26	10.614727	
## PaymentMethod=Bank transfer (automatic)	1.180908e-24	10.250207	
## PaymentMethod=Mailed check	3.226893e-15	7.881803	
## OnlineBackup=Yes	3.021982e-12	6.976698	
## DeviceProtection=Yes	2.173366e-08	5.597602	

## MultipleLines=No	6.262488e-03	2.733712	
## MultipleLines=Yes	7.843169e-04	-3.358271	
## StreamingMovies=Yes	2.922571e-07	-5.128373	
## StreamingTV=Yes	1.283457e-07	-5.281193	
## StreamingTV=No	6.049871e-27	-10.748094	
## StreamingMovies=No	1.092934e-27	-10.904833	
## SeniorCitizen=1	3.024931e-34	-12.202212	
## Partner=No	6.170871e-37	-12.696658	
## Dependents=No	3.572324e-46	-14.265846	
## PaperlessBilling=Yes	1.072745e-60	-16.435085	
## DeviceProtection=No	1.116896e-99	-21.192627	
## OnlineBackup=No	3.366400e-112	-22.509287	
## PaymentMethod=Electronic check	1.790860e-136	-24.864755	
## InternetService=Fiber optic	2.289126e-148	-25.941138	
## TechSupport=No	1.899538e-183	-28.883947	
## OnlineSecurity=No	6.171504e-190	-29.396034	
## Contract=Month-to-month	3.620915e-283	-35.959308	
##			
## \$Yes			
##	Cla/Mod	Mod/Cla	Global
## Contract=Month-to-month	42.709677	88.550027	55.01917
## OnlineSecurity=No	41.766724	78.170144	49.66634
## TechSupport=No	41.635474	77.367576	49.31137
## InternetService=Fiber optic	41.892765	69.395399	43.95854
## PaymentMethod=Electronic check	45.285412	57.303371	33.57944
## OnlineBackup=No	39.928756	65.971108	43.84495
## DeviceProtection=No	39.127625	64.794007	43.94434
## PaperlessBilling=Yes	33.565092	74.906367	59.22192
## Dependents=No	31.279140	82.557517	70.04118
## Partner=No	32.957979	64.205457	51.69672
## SeniorCitizen=1	41.681261	25.468165	16.21468
## StreamingMovies=No	33.680431	50.187266	39.54281
## StreamingTV=No	33.523132	50.401284	39.89777
## StreamingTV=Yes	30.070188	43.552702	38.43533
## StreamingMovies=Yes	29.941435	43.766720	38.79029
## MultipleLines=Yes	28.609896	45.478866	42.18373
## MultipleLines=No	25.044248	45.425361	48.13290
## DeviceProtection=Yes	22.502064	29.159979	34.38875
## OnlineBackup=Yes	21.531494	27.982879	34.48814
## PaymentMethod=Mailed check	19.106700	16.479401	22.88797
## PaymentMethod=Bank transfer (automatic)	16.709845	13.804173	21.92248
## InternetService=DSL	18.959108	24.558587	34.37456
## PaymentMethod=Credit card (automatic)	15.243101	12.413055	21.61011
## SeniorCitizen=0	23.606168	74.531835	83.78532
## Partner=Yes	19.664903	35.794543	48.30328
## Dependents=Yes	15.450237	17.442483	29.95882
## TechSupport=Yes	15.166341	16.586410	29.02172
## OnlineSecurity=Yes	14.611194	15.783842	28.66676
## Contract=One year	11.269518	8.881755	20.91438
## PaperlessBilling=No	16.330084	25.093633	40.77808
## StreamingMovies=No internet service	7.404980	6.046014	21.66690
## StreamingTV=No internet service	7.404980	6.046014	21.66690
## TechSupport=No internet service	7.404980	6.046014	21.66690
## DeviceProtection=No internet service	7.404980	6.046014	21.66690


```

## OnlineBackup=No internet service      7.404980  6.046014 21.66690
## OnlineSecurity=No internet service     7.404980  6.046014 21.66690
## InternetService=No                    7.404980  6.046014 21.66690
## Contract=Two year                      2.831858  2.568218 24.06645
##                                     p.value    v.test
## Contract=Month-to-month               3.620915e-283  35.959308
## OnlineSecurity=No                     6.171504e-190  29.396034
## TechSupport=No                        1.899538e-183  28.883947
## InternetService=Fiber optic           2.289126e-148  25.941138
## PaymentMethod=Electronic check        1.790860e-136  24.864755
## OnlineBackup=No                       3.366400e-112  22.509287
## DeviceProtection=No                   1.116896e-99   21.192627
## PaperlessBilling=Yes                   1.072745e-60   16.435085
## Dependents=No                         3.572324e-46   14.265846
## Partner=No                            6.170871e-37   12.696658
## SeniorCitizen=1                       3.024931e-34   12.202212
## StreamingMovies=No                    1.092934e-27   10.904833
## StreamingTV=No                        6.049871e-27   10.748094
## StreamingTV=Yes                       1.283457e-07    5.281193
## StreamingMovies=Yes                   2.922571e-07    5.128373
## MultipleLines=Yes                     7.843169e-04    3.358271
## MultipleLines=No                      6.262488e-03   -2.733712
## DeviceProtection=Yes                   2.173366e-08   -5.597602
## OnlineBackup=Yes                      3.021982e-12   -6.976698
## PaymentMethod=Mailed check             3.226893e-15   -7.881803
## PaymentMethod=Bank transfer (automatic) 1.180908e-24  -10.250207
## InternetService=DSL                    2.545367e-26  -10.614727
## PaymentMethod=Credit card (automatic)  6.408166e-32  -11.758206
## SeniorCitizen=0                       3.024931e-34  -12.202212
## Partner=Yes                           6.170871e-37  -12.696658
## Dependents=Yes                        3.572324e-46  -14.265846
## TechSupport=Yes                       1.323174e-46  -14.334963
## OnlineSecurity=Yes                     1.606459e-50  -14.947938
## Contract=One year                      3.593041e-57  -15.935502
## PaperlessBilling=No                    1.072745e-60  -16.435085
## StreamingMovies=No internet service     6.584621e-98  -20.999812
## StreamingTV=No internet service         6.584621e-98  -20.999812
## TechSupport=No internet service         6.584621e-98  -20.999812
## DeviceProtection=No internet service    6.584621e-98  -20.999812
## OnlineBackup=No internet service        6.584621e-98  -20.999812
## OnlineSecurity=No internet service      6.584621e-98  -20.999812
## InternetService=No                     6.584621e-98  -20.999812
## Contract=Two year                      3.588830e-187  -29.178937

```

```
res.cat$quanti.var
```

```

##              Eta2      P-value
## tenure      0.12406504 7.999058e-205
## TotalCharges 0.03933251 2.127212e-63
## MonthlyCharges 0.03738671 2.706646e-60

```

```
res.cat$quanti
```

```

## $No
##              v.test Mean in category Overall mean sd in category

```

```
## tenure          29.55784          37.56997          32.37115          24.11145
## TotalCharges    16.64270          2549.91144          2279.73430          2329.72904
## MonthlyCharges -16.22582          61.26512          64.76169          31.08964
##               Overall sd          p.value
## tenure          24.55774 5.207314e-192
## TotalCharges    2266.63354 3.418341e-62
## MonthlyCharges  30.08791 3.312724e-59
##
## $Yes
##               v.test Mean in category Overall mean sd in category
## MonthlyCharges  16.22582          74.44133          64.76169          24.65945
## TotalCharges    -16.64270          1531.79609          2279.73430          1890.31709
## tenure          -29.55784          17.97913          32.37115          19.52590
##               Overall sd          p.value
## MonthlyCharges  30.08791 3.312724e-59
## TotalCharges    2266.63354 3.418341e-62
## tenure          24.55774 5.207314e-192
```

Regarding to the results of the test χ^2 all correlations with the variables are significant since the p – value is less than 0,05. Since the response variable is binary, we have different results for each answer and also for all outcomes of the categorical parameters.

For example, we can analyse in detail the variable “Contract”. For the customers that haven’t churned, the correlation between the ones that have a contract of two year is directly proportional and it’s the highest relation. However, we can see that is the costumer has churned the ones that have a two-year contract have an strong negative correlation. The ones that have a month-to-month contract are the opposite of the previous answer; they have the highest positive correlation with the costumers that have churned and the negative with the ones that haven’t.

Besides the latter variable, we can observe the parameter that have a higher positive correlation with the costumers that churn is the parameter “OnlineSecurity” and “TechSupport” when the answer is “No”. The parameters that have a negative relation with the costumers that churn are when they haven’t hired an Internet Service. We can see that all parameters that have an answer that is “No internet service” have also a negative relation with the response variable “Yes”. We can deduce that they might have multicollinearity with the parameter Internet Service, but we will check it later.

The parameters that have a higher positive relation with the costumers that don’t churn are the ones that have a negative relation when the response variable is “Yes”, that we have analysed before. In the same vein, we can observe that the parameters that have a negative relation with the costumers that churn are “OnlineSecurity” and “TechSupport” when the answer is “No”, the same parameters that have a positive relation when the costumers churn. We can see that the target answer “Yes” and “No” have an approximate opposite correlations with the explanatory variables.

Modelling

Data transformations:

Recall that the following variables:

- OnlineSecurity
- OnlineBackup
- DeviceProtection
- TechSupport
- StreamingTV
- StreamingMovies

are categorical variables with 3 levels: No/No internet service/Yes.

We observe that they contain “No internet service” as a response. We have a variable called “*InternetService*” that is a categorical variable with 3 levels: DSL/Fiber optic/No. Whenever *InternetService*=“No” implies -> var=“No internet service”. Therefore we decided to transform the level “No internet service” into “No” in the 6 variables above since this variable will specify.

```
df$OnlineSecurity[df$OnlineSecurity=="No internet service"] <- "No"
df$OnlineBackup[df$OnlineBackup=="No internet service"] <- "No"
df$DeviceProtection[df$DeviceProtection=="No internet service"] <- "No"
df$TechSupport[df$TechSupport=="No internet service"] <- "No"
df$StreamingTV[df$StreamingTV=="No internet service"] <- "No"
df$StreamingMovies[df$StreamingMovies=="No internet service"] <- "No"
### aqui el phone falta explicar
df$MultipleLines[df$MultipleLines=="No phone service"] <- "No"
summary(df)
```

```
##   customerID      gender SeniorCitizen Partner  Dependents
## Length:7043      Female:3488   0:5901      No :3641   No :4933
## Class :character  Male :3555   1:1142      Yes:3402  Yes:2110
## Mode  :character
##
##
##
##      tenure      PhoneService      MultipleLines      InternetService
## Min.   : 0.00   No : 682      No           :4072   DSL           :2421
## 1st Qu.: 9.00   Yes:6361   No phone service: 0   Fiber optic:3096
## Median :29.00           Yes           :2971   No           :1526
## Mean   :32.37
## 3rd Qu.:55.00
## Max.   :72.00
##
##      OnlineSecurity      OnlineBackup
## No           :5024   No           :4614
## No internet service: 0   No internet service: 0
## Yes           :2019   Yes           :2429
##
##
##
##      DeviceProtection      TechSupport
## No           :4621   No           :4999
## No internet service: 0   No internet service: 0
## Yes           :2422   Yes           :2044
##
##
##
##      StreamingTV      StreamingMovies      Contract
## No           :4336   No           :4311   Month-to-month:3875
## No internet service: 0   No internet service: 0   One year       :1473
## Yes           :2707   Yes           :2732   Two year       :1695
##
##
##
##      PaperlessBilling      PaymentMethod      MonthlyCharges
## No :2872      Bank transfer (automatic):1544   Min.   : 18.25
## Yes:4171      Credit card (automatic) :1522   1st Qu.: 35.50
```

```
##           Electronic check      :2365  Median : 70.35
##           Mailed check          :1612  Mean   : 64.76
##                                           3rd Qu.: 89.85
##                                           Max.    :118.75
##   TotalCharges   Churn
##   Min.      :    0.0   No :5174
##   1st Qu.: 398.6   Yes:1869
##   Median :1394.5
##   Mean   :2279.7
##   3rd Qu.:3786.6
##   Max.   :8684.8
```

Modelling:

Train - test → dubte: abans o després de balancejar les dades? The dataset is imbalanced. Use only glm() modeling tools (parametric and traditional statistical models, baseline for comparison to ML approaches being developed in other subjects) Assessment metric: area under the ROC curve score and confusion table prediction capability analysis (recall, F1-score, etc) for train sample and confusion table for test sample

```
set.seed(1234)
m <- floor(0.7*nrow(df))
train_d <- sample(seq_len(nrow(df)),size = m)

train <- df[train_d,]
test  <- df[-train_d,]

names(df)
```

```
## [1] "customerID"      "gender"          "SeniorCitizen"   "Partner"
## [5] "Dependents"       "tenure"          "PhoneService"    "MultipleLines"
## [9] "InternetService" "OnlineSecurity"  "OnlineBackup"    "DeviceProtection"
## [13] "TechSupport"     "StreamingTV"     "StreamingMovies"  "Contract"
## [17] "PaperlessBilling" "PaymentMethod"   "MonthlyCharges"  "TotalCharges"
## [21] "Churn"
```

Target variable is Churn.

We start the modeling by the null model.

```
mod0 <- glm(Churn ~ 1, data=train, family=binomial)
mod0$deviance
```

```
## [1] 5694.218
```

We continue by adding the numerical variables and assessing the model.

```
which(sapply(df, is.numeric))
```

```
##           tenure MonthlyCharges   TotalCharges
##                6              19              20
```

We start by *tenure*

```
mod1 <- glm(Churn ~ tenure, data=train, family=binomial)
mod1$deviance;AIC(mod0,mod1) #summary(mod1)
```

```
## [1] 5040.677
```

```
##      df      AIC
## mod0  1 5696.218
```

```

## mod1  2 5044.677
anova( mod0, mod1, test="Chisq")

## Analysis of Deviance Table
##
## Model 1: Churn ~ 1
## Model 2: Churn ~ tenure
##   Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1      4929      5694.2
## 2      4928      5040.7  1    653.54 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Add MonthlyCharges
mod2 <- glm(Churn ~ tenure + MonthlyCharges, data=train, family=binomial)
mod2$deviance

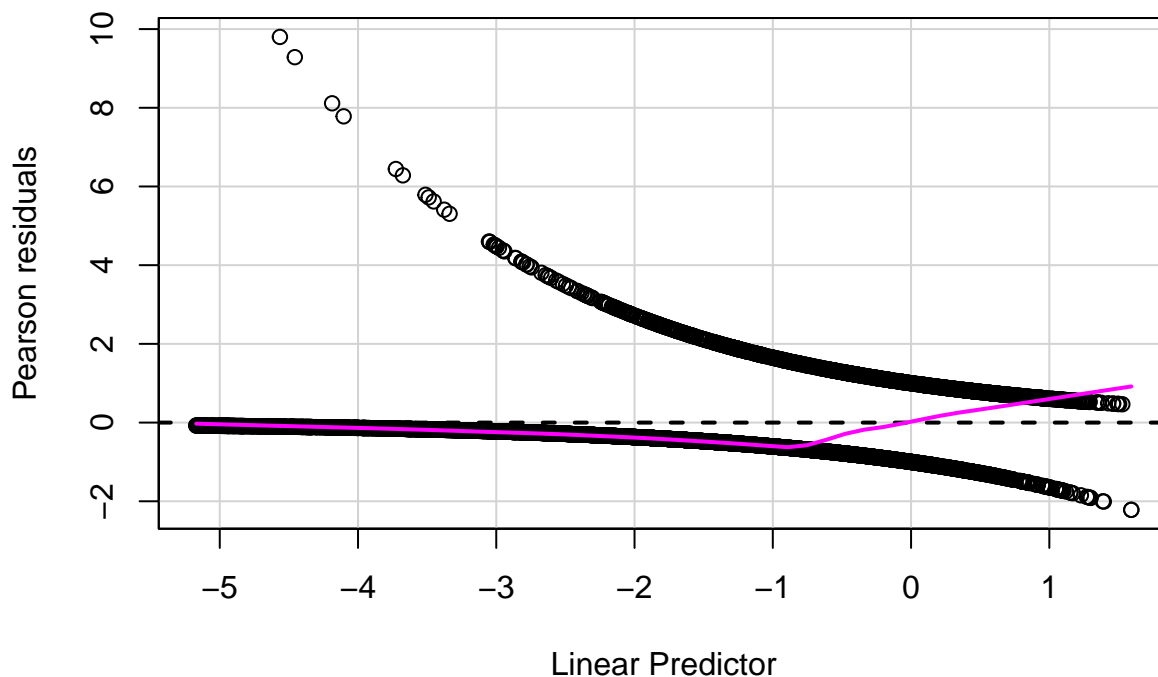
## [1] 4467.45
summary(mod2) #4473.5

##
## Call:
## glm(formula = Churn ~ tenure + MonthlyCharges, family = binomial,
##      data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.8856  -0.7071  -0.4152   0.7722   3.0250
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -1.878261   0.105561  -17.79  <2e-16 ***
## tenure        -0.054752   0.002028  -27.00  <2e-16 ***
## MonthlyCharges  0.033675   0.001574   21.39  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4467.5  on 4927  degrees of freedom
## AIC: 4473.5
##
## Number of Fisher Scoring iterations: 5
anova( mod1, mod2, test="Chisq")

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure
## Model 2: Churn ~ tenure + MonthlyCharges
##   Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1      4928      5040.7
## 2      4927      4467.5  1    573.23 < 2.2e-16 ***

```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
residualPlot(mod2)
```



Add TotalCharges

```
mod3 <- glm(Churn ~ tenure + MonthlyCharges + TotalCharges, data=train, family=binomial)
mod3$deviance
```

```
## [1] 4460.555
```

```
anova( mod2, mod3, test="Chisq") #significant
```

```
## Analysis of Deviance Table
```

```
##
```

```
## Model 1: Churn ~ tenure + MonthlyCharges
```

```
## Model 2: Churn ~ tenure + MonthlyCharges + TotalCharges
```

```
##   Resid. Df Resid. Dev Df Deviance Pr(>Chi)
```

```
## 1      4927      4467.5
```

```
## 2      4926      4460.6  1    6.8951 0.008643 **
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(mod3) #4468.6
```

```
##
```

```
## Call:
```

```
## glm(formula = Churn ~ tenure + MonthlyCharges + TotalCharges,
##      family = binomial, data = train)
```

```
##
```

```
## Deviance Residuals:
```

```
##      Min       1Q   Median       3Q      Max
```

```
## -1.8345  -0.7367  -0.4033   0.7948   3.2105
```

```
##
```

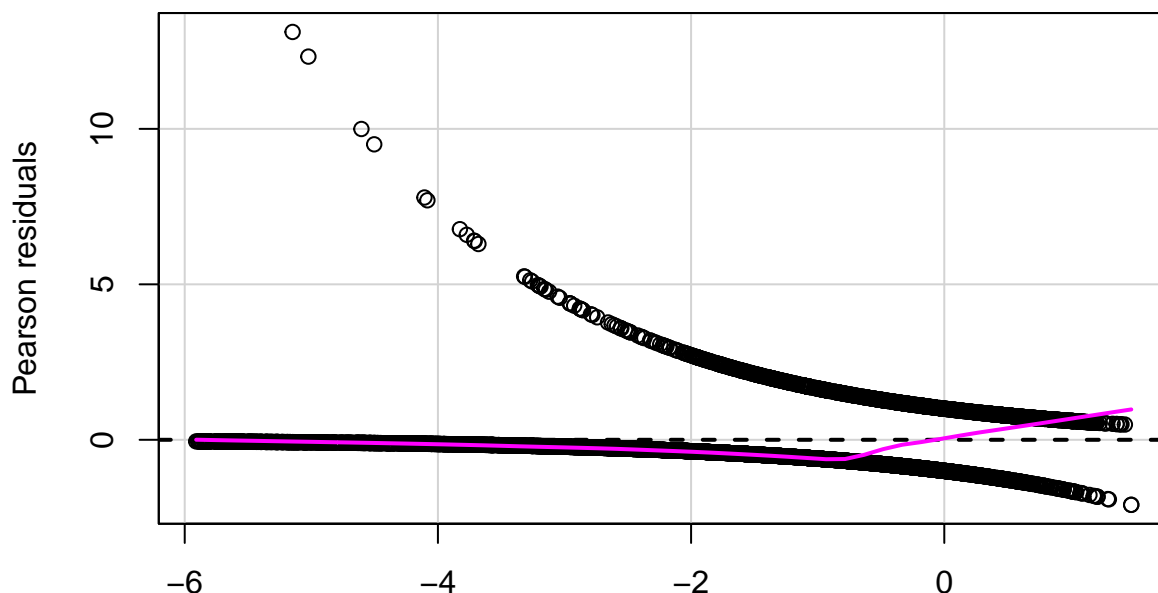
```
## Coefficients:
```

```
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -1.623e+00  1.416e-01 -11.460 < 2e-16 ***
## tenure       -7.113e-02  6.744e-03 -10.547 < 2e-16 ***
## MonthlyCharges 3.012e-02  2.057e-03  14.641 < 2e-16 ***
## TotalCharges  1.945e-04  7.493e-05   2.596  0.00943 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 5694.2 on 4929 degrees of freedom
## Residual deviance: 4460.6 on 4926 degrees of freedom
## AIC: 4468.6
##
## Number of Fisher Scoring iterations: 6
```

```
vif(mod3)
```

```
##          tenure MonthlyCharges    TotalCharges
##      14.730657      2.271293      18.869079
```

```
residualPlot(mod3)
```



It is significant enough but we can also see that *TotalCharges* has a high VIF, so it has high multicollinearity. We decide to not include it in the model.

Infuential data

```
infl <- influence.measures(mod3)
infl$infmat
```

```
##          dfb.1_      dfb.tenr      dfb.MntC      dfb.Tt1C      dffit
## 1004  3.460483e-04 -5.474829e-03  3.012770e-04  4.743974e-03 -0.006648053
## 623   4.580138e-03 -8.626553e-03 -4.766786e-03  6.587069e-03 -0.016284078
## 2693 -2.631932e-03 -9.510635e-03  1.605308e-03  8.552946e-03 -0.015720163
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## 934 -7.220408e-03 -7.133924e-04 1.770039e-02 -6.146152e-03 0.028773946
## 4496 4.527437e-03 -7.914022e-03 7.328150e-03 1.252304e-03 0.029142296
## 2948 1.223057e-03 -3.201537e-03 -4.056472e-04 1.725032e-04 -0.015181307
## 2146 2.084516e-07 -8.510696e-04 -1.024371e-02 5.683655e-03 -0.027569382
## 3175 1.396286e-03 -4.759000e-03 -6.764540e-04 4.076244e-03 -0.005229676
## 2774 -2.977123e-03 -7.197119e-03 3.282387e-03 5.957467e-03 -0.011863528
## 5722 -1.441267e-03 -9.335721e-03 1.139349e-03 7.990434e-03 -0.014164998
## 2374 1.297571e-03 -3.853669e-03 -6.720386e-04 3.287865e-03 -0.004186633
## 1103 2.048572e-02 -1.453763e-02 -8.136051e-03 9.665728e-03 0.033932210
## 4046 -2.664332e-03 8.806404e-03 1.230518e-02 -1.292190e-02 0.030486375
## 7028 1.969712e-03 -4.229080e-03 -1.099893e-02 8.335540e-03 -0.026104370
## 4366 1.365912e-03 -5.242487e-03 5.708588e-05 3.290781e-03 -0.008410950
## 3454 -2.632026e-03 2.145293e-03 4.405396e-03 -5.470643e-03 -0.013284639
## 2232 3.593559e-03 -1.651202e-03 7.247300e-03 -3.216100e-03 0.028362899
## 2622 1.144705e-03 -4.200346e-03 7.936241e-05 2.696452e-03 -0.006381049
## 6148 5.055910e-03 1.075750e-03 -7.480482e-03 -2.764432e-03 -0.024607912
## 3972 1.713489e-02 3.622466e-02 -1.962381e-02 -2.914883e-02 0.061570742
## 1685 1.813879e-03 -1.093318e-02 -1.047359e-03 9.600561e-03 -0.012926799
## 2600 1.168368e-03 -4.049509e-03 -1.452665e-04 2.885799e-03 -0.005384232
## 5332 2.067166e-03 -8.996094e-03 -1.027705e-03 7.649148e-03 -0.010377995
## 3000 -6.196716e-03 -4.441559e-03 6.221781e-03 3.136922e-03 -0.012124977
## 5315 1.365199e-03 -4.217222e-03 -5.106462e-04 3.335527e-03 -0.004935110
## 996 -1.260473e-02 1.935956e-02 1.547607e-02 -1.683933e-02 0.037056685
## 3583 7.937581e-03 2.380992e-03 -2.508383e-02 8.553438e-03 -0.045436293
## 479 -1.379651e-02 3.595773e-03 2.302516e-02 -1.040327e-02 0.029520184
## 3677 3.677770e-03 -1.238870e-02 -4.684126e-03 1.135295e-02 -0.017013523
## 634 -1.582454e-02 2.472415e-03 1.427174e-02 -3.800768e-03 -0.018432777
## 4997 2.562653e-03 -8.876384e-03 -1.415790e-03 6.781732e-03 -0.012067657
## 578 -1.036619e-03 -7.943755e-04 -9.758067e-03 6.089675e-03 -0.028652884
## 3759 -2.673120e-02 1.958250e-02 1.554058e-02 -1.581520e-02 -0.034964006
## 3496 -3.968994e-04 -5.019752e-03 1.173604e-02 -1.882372e-03 0.028517337
## 1403 2.162622e-02 2.217890e-02 -1.904518e-02 -1.832382e-02 0.051475664
## 4052 -6.872492e-04 -6.085959e-04 2.454477e-03 -2.291687e-03 -0.011096330
## 5228 2.745353e-02 -7.558718e-03 -4.537520e-02 2.049408e-02 -0.057945047
## 131 8.751899e-03 4.338312e-04 -2.121126e-02 6.324015e-03 -0.035803940
## 3415 1.818745e-03 -6.983711e-03 -9.613043e-04 6.118871e-03 -0.007715368
## 1014 -2.676677e-02 1.959607e-02 1.558830e-02 -1.584011e-02 -0.034966892
## 4836 -4.016226e-03 6.473592e-03 5.749480e-03 -1.078435e-02 -0.020322428
## 3912 1.403288e-02 1.631822e-02 -8.814015e-03 -1.488458e-02 0.039881301
## 6048 -4.882867e-03 -1.043097e-03 -2.537610e-03 3.559184e-03 -0.021567267
## 298 1.037773e-02 -1.956241e-03 -1.448235e-02 1.791668e-03 -0.028245992
## 1835 3.746798e-02 -2.612245e-02 -2.465428e-02 2.257871e-02 0.044711530
## 258 -5.033981e-03 2.331276e-02 3.343535e-03 -2.765686e-02 -0.043659688
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## 4403 -1.017304e-02 5.671241e-02 4.701383e-03 -4.899925e-02 0.066288408
## 902 -1.378188e-02 2.139808e-03 2.306889e-02 -8.620066e-03 0.029966213
## 5341 4.333118e-03 -8.339651e-03 -4.898613e-03 6.488519e-03 -0.016413912
## 3808 -1.463813e-02 -1.508383e-03 2.316489e-02 -2.633372e-03 0.034329772
## 561 -3.756135e-03 1.077533e-02 4.457930e-03 -1.537020e-02 -0.027934666
## 3385 1.268654e-03 -5.171337e-03 1.022099e-02 -1.285121e-03 0.028697678
## 4232 9.611852e-04 -3.965318e-03 3.107961e-04 2.350963e-03 -0.006576694

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## 1169 -3.508732e-02  2.120595e-02  3.014352e-02 -2.215447e-02 -0.035483477
## 959   6.543327e-03 -8.794139e-03 -1.113994e-02  9.727590e-03 -0.021471098
## 2171 -1.749558e-03 -8.889511e-03 -7.978957e-04  8.602727e-03 -0.016798626
## 5896  2.109375e-03 -1.047188e-02 -1.251055e-03  8.860524e-03 -0.012678063
## 1258  1.197773e-03 -6.031044e-03 -4.361591e-04  5.243248e-03 -0.006839954
## 608   1.974716e-03 -6.829256e-03 -1.069479e-03  5.917618e-03 -0.007509272
## 4591 -1.578890e-03  3.733991e-03  2.808135e-03 -7.744139e-03 -0.020016521
## 4630 -1.220065e-02 -1.363189e-04  1.137544e-02 -1.274891e-03 -0.015593174
## 2851 -2.157233e-03  2.889490e-03  3.679539e-03 -6.756541e-03 -0.017491890
## 3369  1.251228e-03 -6.852220e-04 -1.195093e-03 -2.337900e-03 -0.018275412
## 6352 -3.912228e-03 -6.668508e-03  3.755617e-03  1.428489e-02  0.050960028
## 1155  9.799688e-04 -4.897543e-03 -3.628075e-04  4.308787e-03 -0.005519743
## 2902 -1.015729e-03 -4.946370e-04  2.708980e-03 -2.270913e-03 -0.010379740
## 4665 -2.426238e-04 -4.634588e-03  1.165061e-02 -2.181227e-03  0.028687017
## 1546 -2.892993e-03  5.530837e-03  4.538198e-03 -9.818248e-03 -0.020588216
## 951   3.682694e-02 -2.395040e-02 -2.435135e-02  2.070408e-02  0.043934665
## 3990 -1.989987e-02  6.711297e-03  1.528062e-02 -6.774857e-03 -0.023085632
## 2296  6.886281e-02 -4.244637e-02 -5.736763e-02  4.322396e-02  0.070429030
## 1389 -9.280759e-03  2.772944e-04  2.946419e-03  1.311406e-03 -0.020316502
## 2713 -1.975747e-02  5.720505e-03  1.657127e-02 -6.531126e-03 -0.022130589
## 1667 -1.972676e-02  6.105458e-03  1.756422e-02 -7.435364e-03 -0.021320619
## 595   -2.930414e-02  2.053144e-02  1.906406e-02 -1.762780e-02 -0.035270611
## 434   2.480993e-02  1.905743e-03 -1.690280e-02 -1.941460e-03  0.039021773
## 6901 -2.075094e-04 -5.786969e-05  1.053389e-03 -3.339127e-03 -0.016853336
## 760   -4.041825e-04 -1.762915e-03  1.956720e-03 -5.880840e-04 -0.008603910
## 3290  3.604689e-03 -5.719694e-03 -3.973746e-03  3.458665e-03 -0.016744178
## 1751  3.939436e-03 -7.424040e-03 -2.849820e-03  4.718457e-03 -0.014806390
## 3910 -1.470677e-02  1.763025e-03  1.344155e-02 -3.155267e-03 -0.017429497
## 2324 -1.069662e-02 -1.871201e-03  1.808632e-02  1.045713e-04  0.034314160
## 4265  2.352720e-04  8.474012e-03 -1.425756e-03 -1.173288e-02 -0.028343546
## 1983 -1.062480e-02 -1.572303e-03  9.976304e-03  2.097857e-04 -0.014801021
## 5191  1.558118e-02 -7.480294e-05 -2.329936e-02  2.750978e-03 -0.036882198
## 573   -4.910900e-03 -1.193123e-03 -3.328277e-03  4.383134e-03 -0.023309196
## 4960  7.632226e-02 -4.620311e-02 -6.540434e-02  4.816710e-02  0.077244391
## 1971 -5.743813e-03 -1.389106e-04  1.657218e-02 -6.372771e-03  0.029280803
## 326   2.556772e-03  3.391933e-04 -1.944923e-03 -3.884686e-03 -0.021200055
## 3967 -7.048999e-03  1.062960e-02  8.982273e-03 -1.525553e-02 -0.022704673
## 2533  7.126119e-03 -1.423256e-03 -9.023021e-03 -4.360847e-04 -0.024787434
## 5787  5.168081e-04 -3.254786e-03  8.480797e-04  1.413571e-03 -0.006999451
## 6604 -3.953074e-03 -2.042060e-03 -3.071228e-03  4.330802e-03 -0.021018443
## 4936  9.362559e-04 -4.861283e-03 -3.173081e-04  4.264266e-03 -0.005501591
## 6204 -4.020470e-03  5.995691e-03  5.905355e-03 -1.016549e-02 -0.018928022
## 2497 -7.011749e-03 -3.874820e-03  6.937870e-03  2.546376e-03 -0.012491676
## 4644 -1.097650e-02  1.089925e-02 -2.690327e-03 -4.160883e-03 -0.033963101
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## 3091  2.495284e-02 -1.937095e-02 -1.214253e-02  1.442450e-02  0.036736207
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## 4415 -4.720897e-03 -5.278298e-03  4.938530e-03  4.028902e-03 -0.011352604
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## 102   -3.506857e-02  2.118087e-02  3.015719e-02 -2.214690e-02 -0.035453823
## 214   -8.686189e-04 -6.449759e-03  1.486003e-03  5.491416e-03 -0.008847682
## 4486 -2.751956e-04 -1.935230e-03  1.943030e-03 -8.577976e-04 -0.010700402
## 5717 -2.077866e-02  1.558787e-02  8.899730e-03 -1.087568e-02 -0.032978391
## 597   -7.129985e-03 -4.024923e-03  3.395658e-03  4.148225e-03 -0.017309513

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## 160 -1.655921e-02 2.870715e-03 1.448887e-02 -4.034950e-03 -0.019326837
## 3149 2.712849e-03 -8.916342e-03 -1.578249e-03 6.772760e-03 -0.012324944
## 2577 -6.434211e-03 1.715134e-02 6.307041e-03 -2.189771e-02 -0.034164896
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## 442 -1.045625e-03 6.229920e-03 9.399505e-04 -9.910382e-03 -0.024221216
## 181 6.141930e-02 -3.864983e-02 -4.945171e-02 3.830623e-02 0.063842634
## 4875 -7.995479e-03 1.665653e-02 9.374327e-03 -1.220182e-02 0.036937923
## 163 -6.017895e-03 9.443373e-03 -9.366359e-03 -9.719862e-04 -0.037870766
## 4324 -6.599979e-03 1.035030e-02 1.095678e-02 -8.644970e-03 0.032226896
## 5034 -3.506377e-02 2.117455e-02 3.016047e-02 -2.214492e-02 -0.035446328
## 4198 9.646949e-03 -8.822433e-03 -1.628686e-02 1.135557e-02 -0.026127062
## 6790 7.624954e-02 -4.616673e-02 -6.532546e-02 4.811884e-02 0.077177003
## 5385 -1.045752e-02 8.790771e-03 -2.255275e-03 -2.712899e-03 -0.031864163
## 6571 -2.783002e-02 1.403342e-02 2.285526e-02 -1.441502e-02 -0.029136041
## 6678 -1.222585e-02 -1.156613e-03 1.070975e-02 1.005860e-05 -0.016844971
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## 3569 2.252140e-02 -8.997464e-03 -3.308719e-02 1.499737e-02 -0.042047245
## 4973 5.870877e-04 -1.624715e-03 -3.531969e-04 1.452174e-03 -0.001707369
## 3769 2.110904e-03 -7.108435e-03 -7.060980e-04 4.989631e-03 -0.010342368
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## 806 1.207905e-03 -4.166420e-03 -8.107606e-05 2.840146e-03 -0.005869165
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## 4766 8.634269e-04 -7.863962e-03 -5.044205e-05 6.824356e-03 -0.009373387
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## 4934 -1.673785e-02 1.101619e-02 5.800183e-03 -6.686999e-03 -0.029689447
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## 6215 9.192344e-04 -4.598969e-03 -3.531239e-04 4.075438e-03 -0.005175305
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## 4987 6.196038e-03 -3.016069e-03 -1.743606e-02 8.939533e-03 -0.031832099
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## 1456 7.925388e-03 7.112583e-03 -1.298739e-02 -7.337987e-03 -0.034282758
## 6011 -3.167746e-03 -6.311933e-03 3.550082e-03 5.099122e-03 -0.010915287
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## 1859 -1.551406e-03 7.963392e-03 9.814877e-03 -1.027637e-02 0.028810979
## 4424 1.619877e-03 -1.043617e-02 -1.736437e-03 8.867715e-03 -0.014509836
## 1171 -7.797781e-03 1.412264e-02 9.792441e-03 -1.940044e-02 -0.028198961
## 1725 2.731631e-02 -6.033571e-03 -4.711259e-02 2.073994e-02 -0.061745710
## 3780 -1.164507e-02 3.912521e-02 1.416238e-03 -2.606386e-02 0.057870209
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## 5204 -4.982558e-03 8.516386e-03 -1.000206e-02 -3.196653e-04 -0.036987718
## 4346 5.755813e-04 -1.575645e-03 -3.589307e-04 1.421836e-03 -0.001649991
## 1991 -9.857008e-03 5.348838e-03 1.955629e-02 -1.031296e-02 0.030645718
## 3936 5.483183e-04 -1.470613e-03 -3.478387e-04 1.331018e-03 -0.001535473
## 529 2.041605e-04 -5.792742e-03 4.502437e-04 5.019649e-03 -0.007150370
## 4377 2.946022e-03 1.529926e-03 -3.702561e-03 -4.394521e-03 -0.022907342
## 3747 5.711141e-03 -8.599266e-03 6.245890e-03 2.009063e-03 0.029358426
## 898 -3.302372e-03 1.042274e-02 3.584465e-03 -1.475127e-02 -0.027755353
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## 4192 -5.739545e-03 1.159288e-02 7.225968e-03 -1.654004e-02 -0.026895738
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## 6987   -1.281043e-02  5.983161e-03  1.929961e-02 -6.980259e-03  0.033972200
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## 4556 -6.019130e-03 -4.583552e-03 6.063092e-03 3.295150e-03 -0.012068817
## 443 -2.759158e-03 1.679938e-02 2.399771e-03 -2.147353e-02 -0.037592836
## 5157 -5.142253e-03 -6.143301e-03 1.691859e-03 6.250168e-03 -0.017350854
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## 105 2.680165e-02 -4.618622e-02 -3.258937e-02 6.310919e-02 0.091089055
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## 1743 -8.602643e-03 -5.742148e-06 1.863945e-02 -6.944452e-03 0.028304882
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## 548 -3.023204e-03 5.347199e-03 4.782765e-03 -9.592364e-03 -0.019867676
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## 6114 3.810233e-03 -8.498446e-03 -8.956406e-03 9.863650e-03 -0.020785914
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## 4259 1.0004604 5.201376e-04 0.0013332586
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## 4756 1.0005718 6.775327e-05 0.0005161667
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## 644 1.0010110 2.806268e-05 0.0005379872
## 2493 0.9991782 2.329330e-04 0.0004309055
## 397 1.0006289 2.960199e-04 0.0011141706
## 345 1.0014340 3.852611e-06 0.0006618931

```



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## 2151 1.0003159 1.058327e-04 0.0005406545
## 3721 1.0012866 1.279250e-05 0.0006164133
## 6681 0.9987157 5.418216e-04 0.0006136435
## 1577 1.0013271 2.908072e-06 0.0005514079
## 4596 1.0012329 7.916008e-06 0.0005249269
## 5766 0.9972806 1.747012e-03 0.0007198527
## 6265 1.0008938 7.232061e-05 0.0007006684
## 3316 1.0019261 6.373666e-05 0.0014090661
## 6290 1.0006457 2.716902e-03 0.0027171515
## 6691 1.0006530 6.437514e-05 0.0005398154
## 6908 0.9977801 9.266037e-04 0.0005731093
## 1518 1.0012325 4.332008e-05 0.0007792287
## 4700 1.0012552 1.090745e-04 0.0010597067
## 666 0.9998678 3.023344e-04 0.0007612589
## 6046 1.0014445 4.711105e-06 0.0006801076
## 6294 1.0013484 1.478107e-05 0.0006838074
## 1892 1.0002884 3.606584e-04 0.0010379859
## 431 0.9920242 1.884520e-02 0.0004377380
## 1394 1.0022389 1.665336e-04 0.0019489988
## 3815 1.0012148 7.304003e-06 0.0005030399
## 3549 1.0013230 1.455224e-05 0.0006610514
## 1152 1.0023128 1.634930e-04 0.0020022254
## 1339 1.0002986 1.450869e-03 0.0019561850
## 3502 1.0012175 9.456796e-06 0.0005284310
## 2855 1.0003543 6.297932e-05 0.0004066259
## 1233 0.9987248 4.226606e-04 0.0005167460
## 445 1.0007581 3.209689e-05 0.0004219421
## 2029 1.0013300 2.410830e-05 0.0007370992
## 3193 1.0012857 8.423576e-07 0.0004850878
## 1243 1.0012586 1.909518e-05 0.0006458374
## 4641 1.0006774 1.249997e-04 0.0007657690
## 5837 1.0017061 7.476908e-05 0.0012705367
## 5873 1.0006667 1.258268e-04 0.0007627044
## 5068 1.0009591 3.424047e-05 0.0005470237
## 6569 1.0015192 5.420121e-05 0.0010436725
## 3375 1.0002372 2.073367e-04 0.0007545245
## 3892 1.0013507 1.470241e-05 0.0006850603
## 2740 1.0016302 5.286901e-05 0.0011248094
## 980 1.0012738 2.088330e-05 0.0006710164
## 6648 1.0011893 4.297857e-06 0.0004443907
## 5179 1.0015603 1.208484e-04 0.0013092423
## 2306 1.0005479 1.021997e-04 0.0006310260
## 1369 1.0011281 1.716437e-05 0.0005326007
## 2698 1.0012141 7.847160e-06 0.0005085025
## 2867 1.0000390 2.389596e-04 0.0007290025
## 4422 1.0006101 5.427158e-05 0.0004739145
## 1732 1.0006652 1.259477e-04 0.0007622812
## 5235 1.0008538 1.452717e-04 0.0009192107
## 5675 1.0013337 2.406260e-06 0.0005515761
## 6950 1.0014181 1.390044e-05 0.0007353494
## 5780 0.9992715 3.133054e-04 0.0005620356
## 4585 1.0012455 4.486334e-06 0.0004961475
## 2205 0.9996441 2.449978e-03 0.0020085839
## 5183 1.0012740 3.627304e-05 0.0007701492

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## 1327 1.0014647 1.263650e-05 0.0007657918
## 1251 1.0013774 6.088068e-05 0.0009665968
## 1412 1.0004023 1.855542e-04 0.0007841460
## 5169 1.0005507 1.334741e-04 0.0007262846
## 47 1.0006460 1.649624e-04 0.0008569936
## 5950 1.0012773 1.337365e-06 0.0004839488
## 820 1.0012176 7.891356e-06 0.0005119072
## 1987 1.0012663 1.258261e-05 0.0005980502
## 6389 1.0002998 1.433273e-03 0.0019471982
## 3657 1.0014755 7.980377e-06 0.0007379039
## 3018 1.0005758 4.404776e-05 0.0004076035
## 5040 1.0009436 1.117799e-04 0.0008724164
## 6792 0.9981323 7.433770e-04 0.0005774361
## 817 1.0012178 1.090771e-04 0.0010349407
## 1 1.0017291 1.807139e-04 0.0015868299
## 4969 1.0012835 1.961767e-06 0.0004984761
## 2965 1.0008997 3.478140e-05 0.0005154746
## 6586 1.0014458 3.315127e-06 0.0006676598
## 1708 0.9998997 2.892914e-04 0.0007545412
## 6720 1.0011468 3.130509e-07 0.0003405592
## 5114 1.0031178 1.245369e-04 0.0026100882
## 458 1.0006447 4.904197e-05 0.0004642500
## 6542 1.0013199 1.745656e-05 0.0006815552
## 4416 1.0012641 3.960769e-06 0.0005062628
## 1980 1.0014231 2.796595e-06 0.0006407788
## 4467 1.0008369 1.190250e-04 0.0008338588
## 1925 1.0002529 9.600535e-05 0.0004855641
## 470 0.9992300 2.164632e-04 0.0004212018
## 3427 1.0006713 1.254683e-04 0.0007639959
## 439 1.0006106 5.318788e-05 0.0004689829
## 1873 1.0014433 3.790841e-06 0.0006700208
## 6156 0.9993506 1.391109e-03 0.0014077806
## 6022 1.0013399 2.976145e-05 0.0007808826
## 4313 1.0007522 4.701570e-05 0.0005061821
## 5159 1.0011425 2.946963e-07 0.0003360116
## 1221 1.0004456 5.244372e-05 0.0003958402
## 6931 1.0007133 1.210088e-04 0.0007726605
## 622 1.0012101 1.755213e-05 0.0005965770
## 7008 1.0012138 2.136130e-06 0.0004356740
## 5619 1.0013873 3.744903e-05 0.0008612792
## 5641 1.0010117 1.112238e-04 0.0009113030
## 6888 1.0014756 7.319124e-06 0.0007324293
## 5317 1.0009857 3.461287e-05 0.0005655419
## 438 1.0036238 1.486129e-04 0.0031129570
## 1141 1.0000316 2.910437e-04 0.0008129694
## 5361 1.0009639 1.174033e-04 0.0009021910
## 2565 0.9999940 1.672417e-04 0.0005715347
## 6546 1.0002583 1.293495e-04 0.0005838946
## 6840 1.0013699 1.282121e-04 0.0011957474
## 4804 1.0006891 5.106860e-05 0.0004955597
## 1928 0.9999959 6.332234e-04 0.0012092126
## 2881 1.0000309 1.681914e-04 0.0005874410
## 5244 1.0001650 1.504117e-04 0.0005992706
## 4013 1.0003119 2.635430e-04 0.0008950162

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## 152 1.0013486 1.224799e-04 0.0011643444
## 2927 1.0037589 1.966218e-04 0.0033150700
## 1354 1.0011845 4.117360e-07 0.0003793982
## 4516 1.0002497 1.852698e-04 0.0007139950
## 3987 1.0013559 2.136607e-05 0.0007387722
## 1541 1.0012472 8.903012e-06 0.0005471772
## 1215 1.0001605 1.831661e-04 0.0006713265
## 260 1.0013215 2.217740e-05 0.0007172843
## 2384 1.0012881 1.789306e-05 0.0006596243
## 4701 1.0008207 1.662716e-04 0.0009551665
## 1863 1.0014690 6.641423e-06 0.0007204192
## 4543 1.0006659 3.736820e-05 0.0004103790
## 2166 1.0013469 2.987764e-05 0.0007869723
## 4321 1.0011277 2.563589e-07 0.0003206741
## 6592 1.0005947 1.270648e-04 0.0007297989
## 624 1.0013317 1.582324e-05 0.0006784037
## 1881 1.0012161 1.103256e-04 0.0010378147
## 3035 1.0012043 1.073875e-04 0.0010205669
## 187 1.0008550 3.319420e-05 0.0004801401
## 5670 1.0008674 7.883540e-05 0.0007119743
## 5174 1.0007990 1.214688e-04 0.0008202596
## 2170 1.0012022 9.348487e-06 0.0005149284
## 4245 1.0014234 2.561187e-06 0.0006385711
## 1668 1.0012597 2.946261e-05 0.0007187250
## 2717 1.0009665 3.077414e-05 0.0005289168
## 906 1.0014707 1.218227e-04 0.0012475814
## 3166 1.0013890 1.257006e-05 0.0007000191
## 4146 1.0002976 7.976200e-05 0.0004486547
## 5375 1.0001868 1.290567e-04 0.0005545120
## 424 1.0014645 4.023599e-06 0.0006922398
## 311 1.0022933 1.643228e-04 0.0019881865
## 5520 1.0003734 1.991895e-04 0.0008000631
## 3443 1.0004293 1.530196e-04 0.0007200301
## 77 1.0013345 1.078587e-05 0.0006385230
## 3199 1.0008323 1.413113e-04 0.0008961395
## 4786 0.9999015 1.557022e-04 0.0005135895
## 3792 1.0000553 1.670608e-04 0.0005943209
## 4913 0.9991911 2.946200e-04 0.0005146697
## 878 1.0013760 9.716109e-06 0.0006646410
## 4976 1.0016394 2.846627e-05 0.0010157855
## 3933 1.0009116 1.154617e-04 0.0008654143
## 1602 1.0009097 4.253935e-05 0.0005672855
## 3485 1.0008010 3.471594e-05 0.0004607534
## 6753 1.0006630 5.039923e-05 0.0004796918
## 6199 1.0013633 1.403152e-05 0.0006901955
## 3867 1.0012726 2.020048e-05 0.0006649962
## 4859 1.0013281 5.987244e-06 0.0005866853
## 1923 1.0009438 3.777917e-05 0.0005596573
## 5413 1.0011637 1.205789e-05 0.0005121597
## 2245 0.9981142 8.821903e-04 0.0006467206
## 973 1.0012909 8.382332e-06 0.0005787583
## 2815 1.0013633 2.724896e-06 0.0005833036
## 2710 1.0013833 1.491249e-05 0.0007138137
## 2221 1.0011867 4.362602e-06 0.0004430880

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## 6707 1.0022613 1.656420e-04 0.0019651302
## 2276 1.0008247 1.168299e-04 0.0008202511
## 3823 0.9997990 7.247740e-04 0.0011949361
## 6087 1.0012960 6.828976e-06 0.0005672476
## 1483 0.9999992 4.891211e-04 0.0010610381
## 5253 1.0021817 5.826116e-05 0.0016082491
## 4221 1.0013215 1.136041e-06 0.0005238474
## 2495 0.9984727 4.432384e-04 0.0004683185
## 2323 1.0013815 2.026049e-06 0.0005926103
## 630 0.9982671 5.952112e-04 0.0005245769
## 34 1.0022464 1.662384e-04 0.0019543909
## 3302 1.0006652 1.259477e-04 0.0007622812
## 404 1.0012833 2.238038e-06 0.0005019455
## 943 1.0003754 5.707158e-05 0.0003898180
## 1029 0.9995477 2.321589e-04 0.0005367561
## 5369 1.0005399 1.267870e-04 0.0007021693
## 5908 1.0009185 1.872670e-04 0.0010621707
## 4438 1.0014139 4.324840e-05 0.0009117546
## 2182 1.0010634 2.062878e-05 0.0005163804
## 4953 0.9994627 1.282257e-03 0.0014059331
## 4559 0.9995034 2.016982e-04 0.0004740041
## 5129 1.0010256 6.692927e-05 0.0007560780
## 5251 0.9999274 4.458479e-04 0.0009772599
## 6135 1.0007820 9.456916e-05 0.0007234107
## 6159 1.0021114 1.391169e-04 0.0017822434
## 6324 1.0009241 1.636819e-04 0.0010081652
## 2390 1.0011959 6.805265e-06 0.0004815083
## 1984 1.0004929 5.279648e-05 0.0004163294
## 2791 1.0001876 8.204813e-04 0.0014747193
## 4909 1.0007359 2.060146e-04 0.0010003322
## 122 1.0016389 7.498390e-05 0.0012189457
## 1175 1.0005885 4.594508e-05 0.0004230279
## 116 0.9996873 7.072772e-04 0.0011269412
## 1033 1.0011556 1.277789e-04 0.0010520394
## 6897 1.0002867 3.860730e-04 0.0010729819
## 4716 1.0011961 1.058508e-05 0.0005227536
## 7042 1.0006129 1.227533e-04 0.0007263270
## 3002 1.0014664 4.883496e-05 0.0009788615
## 4041 1.0013728 1.811963e-06 0.0005817396
## 3909 1.0027125 2.143921e-04 0.0024341228
## 4031 1.0005648 1.160554e-04 0.0006825831
## 3382 1.0009011 2.562774e-05 0.0004536926
## 1943 1.0013998 2.449929e-06 0.0006148572
## 4134 1.0012629 4.221391e-05 0.0007949588
## 2540 1.0012368 6.355103e-07 0.0004343049
## 1801 1.0009425 1.871565e-04 0.0010760959
## 3291 1.0012346 1.175118e-04 0.0010725578
## 6047 0.9999322 3.254267e-04 0.0008220104
## 162 0.9998748 1.771447e-04 0.0005490287
## 1551 0.9999090 3.274870e-04 0.0008151111
## 2875 1.0012061 4.765782e-07 0.0004016890
## 5259 0.9982410 2.171382e-03 0.0012048295
## 4367 1.0004832 6.826294e-05 0.0004793470
## 211 1.0001401 3.342664e-04 0.0009278872

```

```

## 43 1.0013039 2.069610e-05 0.0006929532
## 3524 1.0024737 7.848295e-05 0.0019269157
## 2598 1.0024270 7.436626e-05 0.0018739959
## 2670 1.0006024 1.639683e-04 0.0008319677
## 508 1.0015674 1.052376e-04 0.0012672556
## 6983 1.0012337 3.637518e-06 0.0004747996
## 5055 1.0013020 2.138385e-06 0.0005182226
## 337 1.0001178 5.389431e-04 0.0011742814
## 4392 1.0003407 8.178965e-05 0.0004722660
## 5003 1.0012800 1.180428e-06 0.0004843315
## 3040 1.0012408 2.348098e-06 0.0004637877
## 800 0.9978933 1.348778e-03 0.0007838508
## 2425 1.0004336 1.391506e-03 0.0020035325
## 313 1.0013097 2.925636e-04 0.0015192628
## 1448 1.0008736 1.181813e-04 0.0008520203
## 3934 1.0014852 4.841260e-05 0.0009912625
## 5667 1.0012432 1.863875e-05 0.0006304864
## 2795 1.0010868 2.916655e-05 0.0005949551
## 4829 1.0014716 1.101026e-05 0.0007591973
## 1368 1.0012111 1.063198e-05 0.0005351959
## 4316 1.0010097 1.112678e-04 0.0009102840
## 1012 1.0012650 1.995878e-06 0.0004814989
## 2578 1.0016084 9.906435e-05 0.0012781075
## 2008 1.0009698 1.122157e-04 0.0008893446
## 1548 0.9993094 1.847441e-03 0.0015963147
## 6104 1.0013245 2.177832e-05 0.0007168532
## 6736 1.0012075 7.486592e-06 0.0004990301
## 6992 1.0013075 1.230819e-04 0.0011381575
## 4286 1.0010957 1.873395e-05 0.0005229198
## 3758 1.0012323 1.997340e-05 0.0006324508
## 1604 0.9993968 1.681974e-04 0.0003881231
## 5309 1.0012183 6.379437e-06 0.0004954203
## 6457 1.0012391 1.366375e-05 0.0005859085
## 4336 1.0002813 1.542295e-04 0.0006567370
## 6429 1.0002676 1.329189e-04 0.0005971525
## 1066 1.0000113 1.583059e-04 0.0005583966
## 6721 1.0011867 6.424812e-06 0.0004693846
## 4343 1.0013891 9.093032e-06 0.0006704970
## 837 1.0012468 6.417775e-06 0.0005201109
## 2097 1.0002940 1.511849e-03 0.0019864235
## 1305 1.0003417 1.387134e-04 0.0006438350
## 2024 1.0008345 1.249294e-04 0.0008503622
## 117 1.0014680 8.947271e-06 0.0007393196
## 6170 1.0002880 3.649454e-04 0.0010439622
## 6812 1.0003105 2.664861e-04 0.0008995322
## 6316 1.0013151 1.698449e-05 0.0006740016
## 6098 1.0012034 4.789476e-06 0.0004631306
## 771 1.0013925 3.803687e-05 0.0008684224
## 5556 1.0011374 2.663163e-07 0.0003304080
## 4791 1.0005637 5.144891e-05 0.0004397229
## 4216 1.0022270 5.820431e-05 0.0016477674
## 5632 1.0017704 1.280189e-04 0.0014860872
## 895 1.0012360 9.157551e-06 0.0005404984
## 450 1.0019037 4.043466e-05 0.0012991798

```

```
## 1633 0.9996914 6.158457e-04 0.0010477557
## 48 1.0009988 1.146582e-04 0.0009144615
## 5090 1.0004637 8.343786e-05 0.0005287782
## 6072 1.0018294 3.759595e-05 0.0012227087
## 3490 1.0003886 1.037510e-04 0.0005644838
## 1400 1.0013416 2.653005e-05 0.0007620308
## 3274 0.9983486 6.435759e-04 0.0005781401
## 6628 1.0012619 8.093826e-07 0.0004614607
## 3041 0.9987317 2.686577e-03 0.0015923563
## 3113 1.0016022 2.436229e-05 0.0009613537
## 5625 1.0011861 1.490991e-05 0.0005558370
## 873 1.0011879 4.030172e-07 0.0003825311
## 5866 1.0019580 1.228806e-04 0.0016179271
## 3903 1.0017263 1.807638e-04 0.0015848705
## 4485 0.9999007 2.984994e-04 0.0007690112
## 6360 1.0012215 1.419957e-05 0.0005768473
## 4567 1.0014592 2.537057e-05 0.0008482291
## 5702 1.0002011 1.052600e-04 0.0004941227
## 5851 0.9993455 2.004393e-04 0.0004275422
## 4311 1.0012747 2.574455e-06 0.0004983280
## 4101 1.0013671 1.794775e-06 0.0005761104
## 6741 0.9982685 4.723398e-04 0.0004411563
## 3512 1.0013765 1.791988e-06 0.0005851233
## 3459 0.9997661 1.945837e-04 0.0005449657
## 5335 0.9998875 6.946820e-04 0.0012120374
## 3816 1.0006791 1.221647e-04 0.0007582475
## 5440 0.9997700 2.327754e-04 0.0006135840
## 5318 0.9996840 2.577192e-04 0.0006229407
## 4835 1.0012032 4.828977e-07 0.0003989401
## 3664 0.9999230 4.000975e-04 0.0009190556
```

```
cooks.distance(mod3)
```

```
##          1004          623          2693          934          4496          2948
## 5.078350e-06 3.412186e-05 3.103829e-05 1.152090e-04 1.247693e-04 2.887245e-05
##          2146          3175          2774          5722          2374          1103
## 1.223945e-04 3.128441e-06 1.670383e-05 2.481009e-05 1.999238e-06 1.941827e-04
##          4046          7028          4366          3454          2232          2622
## 1.663243e-04 1.067066e-04 8.269463e-06 2.096199e-05 1.344583e-04 4.702216e-06
##          6148          3972          1685          2600          5332          3000
## 8.506285e-05 2.053088e-03 1.986874e-05 3.330233e-06 1.261333e-05 1.748585e-05
##          5315          996          3583          479          3677          634
## 2.788581e-06 3.181895e-04 4.155355e-04 1.157757e-04 3.731234e-05 4.192032e-05
##          4997          578          3759          3496          1403          4052
## 1.751994e-05 1.331827e-04 1.897568e-04 1.156936e-04 8.988313e-04 1.452333e-05
##          5228          131          3415          1014          4836          3912
## 7.532209e-04 2.275441e-04 6.857832e-06 1.897167e-04 5.058884e-05 4.172481e-04
##          6048          298          1835          258          79          3254
## 6.895876e-05 1.177944e-04 3.606584e-04 2.702127e-04 4.576693e-05 1.497214e-04
##          6449          2744          4403          902          5341          3808
## 1.315514e-03 8.511500e-05 2.435059e-03 1.215607e-04 3.500500e-05 1.775796e-04
##          561          3385          4232          1169          959          2171
## 1.010258e-04 1.224112e-04 5.002375e-06 1.651390e-04 6.616875e-05 3.721639e-05
##          5896          1258          608          4591          4630          2851
## 1.924761e-05 5.377453e-06 6.495054e-06 5.023640e-05 2.951211e-05 3.759917e-05
```

##	3369	6352	1155	2902	4665	1546
##	4.324270e-05	6.274847e-04	3.485468e-06	1.266769e-05	1.187085e-04	5.233820e-05
##	951	3990	2296	1389	2713	1667
##	3.563021e-04	7.116819e-05	1.127595e-03	5.888865e-05	6.293267e-05	5.675236e-05
##	595	434	6901	760	3290	1751
##	1.876436e-04	3.579324e-04	3.573912e-05	8.646614e-06	3.646449e-05	2.715233e-05
##	3910	2324	4265	1983	5191	573
##	3.723258e-05	2.005374e-04	1.100526e-04	2.649827e-05	2.234781e-04	8.189294e-05
##	4960	1971	326	3967	2533	5787
##	1.450869e-03	1.258748e-04	5.800146e-05	6.237792e-05	8.546229e-05	5.681142e-06
##	6604	4936	6204	2497	4644	1911
##	6.501982e-05	3.462884e-06	4.335717e-05	1.860404e-05	1.979114e-04	1.007342e-04
##	3091	2686	4415	2193	102	214
##	2.249380e-04	2.468644e-05	1.524003e-05	1.590203e-05	1.647326e-04	9.085737e-06
##	4486	5717	597	160	3149	2577
##	1.355674e-05	1.738191e-04	4.023047e-05	4.679255e-05	1.833095e-05	1.556535e-04
##	6082	2174	6406	442	181	4875
##	1.899638e-04	5.323162e-04	4.925800e-05	7.730798e-05	8.715938e-04	3.453108e-04
##	163	4324	5034	4198	6790	5385
##	2.616326e-04	2.257831e-04	1.646305e-04	1.036887e-04	1.447338e-03	1.696684e-04
##	6571	6678	40	3613	3569	4973
##	1.127148e-04	3.526357e-05	1.301551e-04	5.570725e-05	3.110750e-04	3.306632e-07
##	3769	6544	5570	806	3672	4766
##	1.267034e-05	3.507480e-06	1.130228e-04	3.966612e-06	1.160173e-04	1.021236e-05
##	3435	4934	478	5523	5495	3407
##	5.961512e-05	1.385927e-04	2.151170e-04	1.246551e-04	1.304186e-04	8.078799e-06
##	6133	598	3214	3991	3475	6803
##	2.203930e-06	1.760445e-04	7.833976e-06	3.398911e-04	9.752689e-06	1.495400e-04
##	6215	6601	4987	5308	1456	6011
##	3.060333e-06	8.462053e-04	1.705496e-04	8.207912e-04	1.801575e-04	1.404356e-05
##	488	3939	912	215	540	3938
##	7.160197e-06	1.715541e-04	2.537869e-04	1.057848e-04	1.004088e-05	1.012591e-04
##	4709	5552	931	2344	1859	4424
##	7.497259e-06	1.590329e-05	8.804555e-05	1.404960e-04	1.583881e-04	2.632035e-05
##	1171	1725	3780	1912	5204	4346
##	9.773184e-05	9.235203e-04	2.367320e-03	4.357623e-05	2.476212e-04	3.087634e-07
##	1991	3936	529	4377	3747	898
##	1.510849e-04	2.673435e-07	5.885327e-06	7.046214e-05	1.275825e-04	1.009117e-04
##	4965	6831	6575	3102	2058	534
##	3.009576e-04	6.094145e-06	4.412963e-04	1.179479e-05	1.768873e-04	6.575150e-05
##	5561	6989	3417	5712	585	3084
##	2.115364e-05	3.985986e-05	9.425883e-05	1.463748e-04	1.203865e-04	9.017432e-07
##	4389	3779	4399	5718	3750	3219
##	1.986539e-05	1.428806e-04	3.282778e-06	2.115663e-06	1.027929e-04	5.834308e-06
##	6039	4203	6687	1542	4871	5960
##	2.537803e-03	4.192435e-05	5.661863e-05	2.176337e-07	1.388972e-05	6.851040e-06
##	3076	2091	6333	911	1937	4267
##	4.137628e-05	3.486104e-06	4.808774e-05	1.405945e-04	9.538807e-06	1.616386e-03
##	4135	810	216	5867	1315	6202
##	6.706567e-05	1.260692e-04	5.872391e-06	1.208972e-04	3.329062e-04	3.557898e-04
##	1938	6539	1208	6600	1046	3242
##	2.944319e-05	1.144478e-04	1.263560e-04	1.436816e-04	6.906388e-05	1.454407e-03
##	588	63	6822	1684	417	4669
##	8.622273e-05	8.090733e-07	1.595327e-04	1.298837e-05	1.958018e-05	1.954074e-04

##	2934	1094	6203	3556	2852	2251
##	4.195322e-07	2.403736e-05	1.749709e-04	1.562816e-04	1.391964e-05	2.417896e-05
##	2017	5363	2461	4673	4638	1977
##	1.393104e-04	5.847335e-07	2.137892e-06	4.442397e-05	3.353879e-06	1.000782e-04
##	2524	5036	522	4501	716	3869
##	2.427615e-06	7.454780e-05	2.576727e-05	6.353313e-05	3.089791e-05	1.814125e-04
##	6751	2549	4525	4874	5078	4301
##	6.771625e-06	1.411186e-04	1.903810e-04	6.445051e-05	6.476188e-05	1.430170e-05
##	3176	1234	2519	3743	2114	2136
##	1.649187e-04	3.596937e-07	2.356619e-04	1.391497e-04	4.883783e-05	8.315239e-05
##	1382	4697	4405	2190	6438	5541
##	2.732384e-04	2.707738e-05	1.122301e-04	3.902962e-07	1.983694e-05	1.422789e-03
##	4811	1454	1852	5852	3433	4020
##	1.386379e-04	9.423271e-05	6.368575e-04	2.695138e-04	1.659851e-05	1.410034e-04
##	2164	2977	480	5135	4582	6398
##	1.999591e-04	1.944741e-05	1.666806e-04	1.437771e-04	9.179502e-07	9.335507e-06
##	725	1826	3563	2329	5298	1452
##	2.349582e-04	2.297309e-05	1.126929e-04	1.294953e-04	1.298842e-06	6.096890e-05
##	1131	3961	2242	2790	3010	2949
##	1.041028e-05	1.572896e-04	1.374890e-06	1.167184e-04	1.746256e-04	3.904897e-04
##	4990	365	5498	4517	6089	1190
##	7.327499e-05	7.838883e-05	3.780027e-03	7.251220e-06	2.044414e-04	5.556986e-04
##	207	3798	5588	5225	5602	6731
##	1.510185e-06	2.250180e-05	3.442570e-05	6.865591e-05	1.418801e-05	2.414080e-05
##	2328	4536	6533	6643	991	251
##	9.296946e-05	2.113085e-04	1.877038e-05	6.276305e-05	1.282563e-05	3.105002e-05
##	3636	1318	613	6607	3039	2148
##	2.912104e-07	1.289492e-04	4.169868e-07	3.264153e-04	5.381905e-05	1.804721e-05
##	2967	6890	141	5890	4074	4475
##	4.114213e-05	7.086984e-04	7.319951e-06	3.687643e-06	1.593704e-04	4.873635e-06
##	4722	4372	1809	2756	3158	4234
##	1.443813e-03	3.295576e-05	2.416972e-04	2.540603e-06	3.446726e-04	2.350752e-05
##	2392	1235	4014	2729	461	1691
##	8.981856e-05	1.036029e-04	1.738415e-04	3.238148e-05	7.332891e-05	1.609377e-05
##	4823	4175	542	6075	2682	1738
##	3.728493e-05	4.775008e-03	6.651195e-05	1.230825e-03	6.709755e-06	8.237435e-05
##	3789	6049	5958	2748	854	1635
##	1.206594e-03	2.184385e-04	1.548097e-04	6.607199e-05	1.535227e-04	3.905945e-06
##	495	2419	2428	2145	6193	7011
##	1.666315e-04	7.000020e-05	6.217084e-04	1.447563e-04	7.868199e-05	1.169000e-04
##	4911	3541	3332	5820	1678	2523
##	2.331188e-04	5.220180e-05	1.946118e-04	1.725054e-04	8.110761e-05	1.685212e-05
##	2222	4241	3626	6889	2231	347
##	2.546338e-06	1.233507e-04	2.412354e-07	4.193919e-04	2.829008e-06	1.077468e-04
##	3958	5905	4238	486	118	3623
##	3.737545e-05	1.941932e-05	1.306476e-04	5.728672e-06	1.208836e-04	9.309006e-06
##	309	357	2203	6677	1702	5579
##	1.013001e-04	4.005949e-05	1.347414e-04	5.285276e-05	1.595648e-03	3.558815e-06
##	61	3638	4848	3251	1296	1100
##	6.700441e-05	1.238434e-03	4.723173e-04	3.687074e-05	5.547119e-06	1.174836e-04
##	1111	3296	4431	3048	1188	13
##	2.065339e-06	4.601160e-06	3.019384e-05	3.005806e-04	3.628701e-05	3.833248e-05
##	4733	1024	2574	41	5267	1600
##	2.419571e-07	2.763504e-05	2.110970e-04	6.026631e-05	2.016649e-05	5.258987e-06

##	772	6040	6478	1119	6972	3960
##	1.430825e-04	1.545704e-03	6.726819e-05	9.786970e-05	1.520608e-04	5.723051e-06
##	2317	731	4842	755	5099	6836
##	1.023205e-04	5.010469e-04	1.637013e-04	7.706832e-04	1.183404e-04	9.802154e-06
##	2101	6511	875	2468	3803	2102
##	2.299134e-05	6.817825e-05	7.932076e-05	5.572966e-05	1.658417e-04	2.897078e-04
##	5755	5503	6286	2879	3346	3286
##	1.340940e-05	1.520696e-04	3.045983e-05	1.218643e-04	2.513810e-05	4.168816e-06
##	3240	6285	5215	191	2891	4790
##	3.765914e-05	1.606620e-04	1.203988e-04	1.913578e-05	1.336995e-03	1.226041e-04
##	3615	6059	2218	5786	2115	5380
##	2.593125e-06	5.323751e-05	1.183949e-05	2.598709e-06	1.658089e-05	3.275836e-05
##	5599	6996	4130	3727	2552	2610
##	1.115225e-06	1.851155e-05	4.013593e-05	1.477082e-04	3.264556e-05	1.272033e-03
##	6701	166	2012	3177	1630	2007
##	3.975664e-05	2.966632e-07	1.845876e-05	2.234840e-06	4.296346e-06	2.999924e-04
##	936	350	5964	5955	3761	5151
##	4.498734e-04	2.922409e-05	7.459604e-05	3.243900e-05	2.850309e-04	1.417838e-04
##	547	2556	491	6452	2663	2628
##	4.024138e-04	9.293641e-05	5.616495e-05	2.319192e-04	2.775444e-04	8.833042e-06
##	5773	6976	2609	11	5269	2020
##	6.155566e-06	3.557478e-05	6.265581e-04	4.706153e-05	8.484458e-06	2.022046e-03
##	3663	2759	5477	3894	19	3535
##	3.385474e-04	8.872598e-05	1.210835e-04	9.248800e-05	2.061516e-04	5.261457e-04
##	4826	2665	1831	784	3948	2968
##	9.107673e-05	2.048646e-05	7.407652e-06	2.408753e-04	1.219997e-04	1.498094e-04
##	3349	4331	5754	793	4765	6988
##	4.405580e-05	1.605193e-04	1.398988e-04	5.508453e-05	3.566233e-04	2.176591e-04
##	2535	1144	6490	4991	5888	199
##	5.173789e-05	3.692779e-05	1.544858e-03	9.543346e-05	3.652441e-05	8.595569e-05
##	6309	3270	865	4710	6660	2030
##	2.694289e-04	5.917007e-07	1.675557e-04	3.023358e-05	1.029881e-05	1.657523e-03
##	3224	2964	3968	3526	930	6142
##	1.337707e-04	8.016485e-06	7.205061e-06	6.396210e-04	6.338751e-05	8.853741e-04
##	5492	618	1309	535	3471	3736
##	3.879637e-05	4.892736e-05	1.722879e-04	1.070207e-04	7.749606e-05	5.563164e-04
##	5121	4705	241	5076	2611	1791
##	2.580485e-04	2.193772e-04	6.656078e-06	4.323369e-05	4.983332e-03	1.369355e-04
##	6913	6562	6733	4949	5677	3705
##	3.281777e-04	1.566724e-04	1.088951e-04	1.357675e-04	1.653409e-04	4.276411e-06
##	4657	4015	6492	998	4297	3937
##	6.335401e-05	1.626587e-04	1.269395e-04	1.063706e-04	4.893926e-04	1.179288e-04
##	4223	5539	2438	6132	576	5855
##	2.215387e-04	1.099669e-04	1.088310e-04	5.064134e-04	1.058662e-05	3.991483e-05
##	3730	4121	633	3413	3734	3729
##	6.017077e-07	5.420703e-05	8.444349e-06	1.892278e-04	1.923191e-05	1.014707e-05
##	638	786	3586	4053	4926	2974
##	4.053604e-06	5.166752e-04	5.659679e-05	1.833892e-03	7.661749e-05	1.394148e-03
##	570	2183	6548	4069	4884	4299
##	4.962976e-05	7.079125e-05	1.130948e-06	2.629537e-05	7.919016e-04	5.974387e-05
##	3232	3406	790	5595	2272	5895
##	1.772128e-04	1.098761e-05	3.001100e-06	9.323501e-05	4.566432e-05	5.354627e-04
##	206	3886	1216	4743	6007	2637
##	3.590231e-05	3.061694e-04	1.157392e-04	2.308928e-07	1.836934e-05	1.179865e-04

##	1095	5357	4929	286	6978	5263
##	2.054407e-05	1.755170e-05	3.262537e-04	5.192827e-05	2.701870e-05	7.363673e-06
##	5110	1811	2624	6626	6381	600
##	4.390727e-06	1.368508e-05	4.499382e-04	1.403510e-04	3.957179e-05	4.542510e-07
##	625	5800	4495	2970	3472	674
##	1.273755e-03	6.430656e-04	5.172006e-04	1.149760e-04	6.289332e-06	1.663933e-05
##	6465	5774	6603	6003	2332	6553
##	1.445950e-05	2.719299e-05	6.616909e-05	1.278640e-04	1.422766e-05	1.139993e-04
##	3687	4478	5439	6272	4257	4059
##	1.376559e-04	3.193248e-05	1.291293e-04	8.012445e-05	3.845433e-07	4.476254e-04
##	5256	5171	4903	6366	352	4227
##	4.510727e-05	1.651390e-04	3.017259e-05	1.151447e-04	3.489225e-05	1.181811e-04
##	6134	6623	3231	801	2695	2859
##	1.490047e-04	1.540348e-04	5.280135e-07	4.213642e-06	5.614417e-05	4.451950e-05
##	6865	3446	1415	4300	4085	6028
##	1.066812e-03	7.983037e-05	7.998493e-05	2.730936e-05	1.126648e-04	7.852671e-06
##	57	1993	4962	2589	3449	1079
##	3.341708e-05	1.545668e-04	3.221881e-05	7.653026e-05	1.565818e-04	1.077118e-05
##	5614	727	4375	2725	2180	1485
##	2.935304e-06	1.688203e-05	2.374541e-07	5.961880e-07	8.713473e-05	2.410183e-05
##	263	5069	2016	3412	4799	3213
##	1.897945e-05	2.573648e-07	2.402710e-05	8.908008e-04	3.089445e-05	2.892751e-05
##	3310	841	5707	4726	704	4319
##	1.136162e-05	8.750825e-04	1.152544e-04	1.543516e-04	1.408112e-04	1.095225e-05
##	5338	4581	6534	23	2621	6706
##	3.176682e-05	2.301304e-07	2.773175e-04	1.450869e-03	5.010687e-05	2.745248e-05
##	4167	1956	5015	2736	2298	1367
##	7.419605e-06	3.919264e-05	1.464108e-06	1.283973e-05	9.799381e-04	1.405679e-04
##	3356	1329	5243	953	383	4741
##	1.152824e-05	3.199167e-05	1.650093e-04	3.099339e-05	2.340826e-06	1.091741e-03
##	6513	946	2340	5685	4565	3882
##	6.973189e-05	1.217060e-04	1.681903e-04	1.274879e-03	1.461501e-03	2.583283e-06
##	4219	2414	2972	3997	4629	3494
##	6.817395e-05	8.278676e-05	1.733939e-05	1.264492e-05	5.405501e-05	1.623600e-04
##	3184	396	124	3428	3622	6235
##	5.700555e-04	1.195627e-05	8.629843e-05	2.119292e-04	1.131151e-03	1.178840e-06
##	4355	5217	848	1003	2595	1041
##	8.076005e-07	7.156164e-03	4.277571e-05	2.110738e-04	7.938325e-05	1.461346e-04
##	1558	870	5426	3057	3489	4560
##	8.144885e-05	1.362447e-04	1.633226e-04	1.425832e-05	8.291289e-05	7.600505e-05
##	1501	3306	5664	5024	3717	6857
##	1.204461e-05	6.371297e-05	7.387169e-05	1.243164e-04	1.265642e-04	1.162295e-06
##	6408	6413	5424	2785	4322	4407
##	4.333262e-05	4.888407e-05	1.485161e-04	1.065625e-04	1.588497e-04	2.905334e-05
##	6015	6510	4492	3377	3015	1302
##	2.914719e-05	1.133481e-03	1.653409e-04	1.646305e-04	3.330986e-05	2.985666e-06
##	2504	1371	5395	1786	1803	2582
##	3.103383e-06	1.028928e-05	1.071594e-04	1.337047e-05	8.008936e-05	4.242024e-05
##	5505	2824	1426	2067	4650	1961
##	4.525032e-04	4.585509e-06	1.395130e-04	6.549923e-07	6.236404e-05	5.749765e-05
##	4853	3344	1056	4220	5636	606
##	3.042706e-07	2.203021e-05	5.618289e-06	1.544070e-05	3.317817e-05	6.405686e-06
##	5089	4058	103	4621	2703	4469
##	9.355365e-07	2.967850e-07	6.410874e-05	1.370771e-04	1.871925e-04	1.106079e-03

##	3633	3106	2573	1017	2976	177
##	6.083612e-05	2.671661e-05	3.310831e-07	4.961033e-06	1.723508e-04	1.427805e-04
##	5996	5082	165	523	1087	2263
##	8.410927e-05	1.110672e-05	3.802622e-05	1.665691e-05	1.300821e-04	1.147415e-04
##	3011	5009	6657	1728	6026	399
##	2.803961e-05	7.455534e-05	2.575365e-06	3.465902e-05	1.132202e-05	2.235192e-05
##	1779	3019	489	4607	5242	4318
##	2.939977e-07	4.952718e-07	2.204405e-04	4.181561e-05	8.054371e-06	1.204300e-04
##	5823	3120	6410	5294	5639	5971
##	3.012847e-05	2.916701e-04	3.190712e-06	4.021545e-05	1.465057e-03	5.875073e-04
##	6883	6680	3379	1672	1363	1710
##	2.375380e-05	1.887469e-06	5.680780e-06	5.278260e-05	1.309880e-04	3.184102e-05
##	6550	4091	474	667	5811	2998
##	1.962686e-04	1.900497e-04	2.881810e-05	1.272026e-04	1.531665e-04	1.846500e-03
##	6585	4123	1150	2214	2326	5441
##	1.860763e-06	8.851156e-06	1.554114e-04	3.631489e-05	1.027421e-04	3.236415e-05
##	5018	3744	4636	6317	2025	5584
##	7.927641e-06	2.761159e-04	4.215313e-06	7.368808e-07	4.792638e-04	2.027470e-04
##	737	2840	3001	4443	6638	6050
##	3.456738e-04	3.733053e-06	1.335983e-04	1.171665e-04	1.832904e-06	2.328637e-06
##	5255	6551	208	1294	4931	4228
##	1.072116e-04	1.625527e-04	1.109632e-04	1.094505e-04	1.873322e-04	5.773952e-06
##	6485	5557	6819	3907	5020	2530
##	5.009733e-05	1.526407e-04	2.518190e-04	1.119461e-04	4.285505e-04	1.860196e-03
##	153	2585	515	3355	6436	4502
##	9.142332e-05	7.095646e-06	1.056428e-04	4.268922e-06	6.553176e-06	4.691952e-06
##	86	1143	4587	6282	4614	5744
##	7.476407e-04	1.473847e-04	2.230088e-04	7.521750e-05	1.151990e-03	4.919459e-06
##	726	962	5343	5746	1890	4153
##	5.022752e-05	2.045682e-05	1.001983e-03	8.410352e-07	3.334244e-05	6.348928e-06
##	3871	6364	4193	886	1065	1335
##	2.105525e-06	1.669740e-04	1.338460e-05	1.659412e-04	4.717846e-05	1.124661e-03
##	3036	6863	4549	6435	2130	225
##	3.499946e-05	1.132556e-04	1.698918e-04	2.642747e-04	1.157577e-04	3.245479e-05
##	6907	6527	6925	2650	1951	6670
##	1.129143e-05	6.595089e-04	1.265623e-04	6.596606e-07	1.478835e-03	1.085477e-04
##	3525	6245	4465	5417	1832	861
##	1.409422e-04	4.316223e-05	1.617826e-04	3.037015e-05	3.917270e-05	1.096012e-05
##	35	3264	2522	4795	400	1308
##	1.875322e-04	1.979029e-05	2.861799e-04	1.411949e-04	1.328632e-05	3.141739e-05
##	5897	2651	5793	6382	2674	5168
##	3.401752e-07	1.741206e-04	1.507456e-04	1.649362e-04	1.635846e-04	8.443479e-06
##	2745	824	6761	1138	3520	4851
##	7.186835e-05	1.490306e-04	2.675263e-04	2.404418e-07	2.862754e-05	4.540416e-05
##	2521	2897	2496	487	1051	5947
##	4.532445e-05	2.949653e-05	4.815498e-06	5.278137e-04	3.916933e-04	7.330716e-04
##	4721	2106	5933	5448	653	2013
##	4.754041e-05	1.194825e-04	1.118467e-04	1.439330e-04	6.119516e-06	4.984402e-04
##	2819	1888	5918	7016	4731	1241
##	2.206553e-04	1.480253e-04	1.000150e-04	4.525848e-05	1.154080e-04	1.145559e-05
##	2302	2210	318	2113	6258	5080
##	4.795897e-04	5.564095e-05	4.213897e-04	2.501776e-05	1.191093e-04	3.783729e-04
##	2527	1401	1981	5392	3196	283
##	1.504582e-03	1.198464e-04	5.390654e-04	9.318321e-05	2.531241e-04	1.752208e-04

##	2004	125	1073	4429	4691	5651
##	9.509095e-04	1.012811e-04	3.127785e-05	1.532120e-04	3.188402e-05	1.915009e-05
##	5409	137	3900	5238	6627	909
##	2.157197e-06	4.922879e-05	1.315674e-04	2.920000e-05	1.171050e-04	5.638101e-05
##	5635	1081	4748	465	4012	2821
##	1.468619e-03	7.449199e-06	6.087225e-06	1.500206e-04	1.292079e-05	1.724990e-06
##	6530	2802	4783	3689	4924	2224
##	1.183003e-04	7.928697e-05	3.108744e-04	6.936152e-05	6.422571e-06	1.805430e-04
##	4182	3848	6233	2416	2507	5373
##	3.600253e-05	4.241710e-05	1.068296e-04	3.530612e-04	2.864537e-07	9.154364e-05
##	702	228	3441	1430	6076	1651
##	4.141154e-05	2.064511e-04	8.618724e-06	3.489695e-06	8.951843e-05	1.064331e-04
##	3058	5203	6380	5586	816	1990
##	1.166597e-05	1.343716e-04	1.365134e-04	1.511849e-03	7.897484e-05	1.593868e-05
##	6862	2818	2966	3767	811	819
##	1.436174e-04	3.933616e-06	8.816521e-04	2.005220e-04	1.145811e-03	1.598667e-04
##	5173	5400	5214	5991	1544	546
##	1.260893e-06	1.796718e-06	2.554515e-04	7.180106e-05	1.316138e-04	3.697434e-05
##	1411	55	3598	6284	1742	4102
##	1.051829e-04	8.581611e-06	1.684791e-04	1.029271e-04	6.789283e-05	1.128211e-04
##	3819	1845	6625	2620	3621	4792
##	1.210533e-04	6.759471e-06	3.747073e-06	2.595761e-04	1.834758e-05	1.186975e-04
##	1206	3738	1285	454	6095	2931
##	1.162824e-04	2.504926e-04	7.904115e-07	2.399308e-04	9.854873e-07	1.012357e-05
##	6664	4776	520	2959	1475	5956
##	1.967945e-04	1.748537e-04	3.364875e-05	1.649362e-04	5.514828e-05	2.821585e-06
##	6772	2208	312	3479	6476	3637
##	7.897483e-06	1.278392e-04	1.407173e-04	6.005842e-05	7.986731e-05	3.714124e-05
##	5572	6915	1563	2388	896	3451
##	9.279765e-06	4.175638e-04	7.742011e-05	1.334394e-03	1.097838e-04	3.939266e-05
##	6817	3914	6231	6475	1211	4703
##	1.243164e-04	2.947814e-07	1.659412e-04	7.507771e-05	1.768785e-04	6.832055e-06
##	5152	6146	4484	4141	4036	7039
##	1.407820e-04	2.290490e-06	5.074114e-07	1.294978e-03	2.930411e-05	8.818343e-05
##	6482	5022	1462	389	3367	679
##	1.934781e-04	8.309487e-05	2.074012e-04	3.576555e-05	8.948629e-05	1.732590e-03
##	3920	6100	164	5532	6216	5408
##	1.216812e-04	3.242410e-07	1.239329e-05	1.349028e-06	1.176043e-04	4.620650e-06
##	4192	4576	3153	5925	4789	1858
##	9.078645e-05	1.095768e-04	1.539645e-04	6.240916e-07	4.517271e-06	3.273135e-06
##	3467	5184	136	3183	2570	510
##	3.011578e-07	3.290272e-04	4.216752e-06	4.697534e-05	2.957335e-07	1.655419e-04
##	5107	5108	4686	1840	1482	2631
##	9.167110e-06	1.228492e-05	1.349101e-04	1.116055e-04	2.370172e-06	1.024107e-05
##	1438	5854	476	30	284	6304
##	2.548808e-05	2.485988e-05	2.114847e-04	1.932376e-04	2.131478e-06	6.211347e-05
##	4126	3506	1337	5686	32	6002
##	3.343683e-05	5.134969e-05	1.001923e-04	2.653785e-06	1.018898e-03	1.744742e-04
##	5186	791	2687	6977	4872	1078
##	1.461305e-05	5.081550e-06	1.718952e-04	7.274489e-06	1.001871e-05	4.017067e-04
##	1587	541	5043	642	2884	1778
##	8.234929e-05	1.121667e-04	1.717187e-05	2.004633e-03	4.678615e-07	2.800137e-05
##	4144	2861	4956	2526	5504	834
##	2.087531e-04	3.366175e-05	1.264380e-04	1.593058e-05	5.916739e-06	4.429290e-05

##	1777	5488	4615	6825	840	5356
##	2.991674e-07	6.884245e-06	6.503101e-05	2.254370e-03	3.081342e-06	4.022569e-05
##	3037	5688	168	485	6008	1503
##	1.818740e-06	3.772961e-05	7.378418e-06	1.278570e-04	1.637047e-05	9.962925e-06
##	4264	818	6212	908	6192	1970
##	1.327834e-04	6.574094e-05	1.158827e-04	4.637122e-05	1.395540e-05	3.936492e-06
##	5388	4138	5819	1346	5953	6778
##	1.143346e-04	3.306341e-05	4.308887e-05	6.266579e-05	1.074261e-04	1.334488e-04
##	6536	648	4628	3005	4904	5980
##	2.684065e-04	1.397612e-05	2.539116e-04	1.038858e-04	1.170605e-04	1.379908e-06
##	995	6151	5681	6111	2099	4970
##	2.971246e-05	7.127132e-05	1.401987e-03	3.970467e-05	7.934116e-04	1.429208e-04
##	1946	3474	484	3891	1776	5725
##	2.509400e-07	4.321263e-04	7.084263e-05	3.508575e-03	8.638244e-05	1.221002e-04
##	1373	1804	5163	2652	95	6813
##	1.881606e-04	1.908023e-05	5.548197e-05	1.656156e-04	2.841878e-05	2.826175e-05
##	5934	2641	3839	3148	3366	3071
##	9.587603e-05	1.955928e-04	2.155717e-04	5.302203e-04	1.705842e-05	9.860509e-05
##	4668	384	1158	2644	4855	1176
##	1.565414e-05	1.024922e-04	2.572760e-05	2.708126e-04	3.315931e-05	1.616403e-04
##	3304	3145	3392	2768	4477	6172
##	1.210021e-04	7.351059e-05	1.006651e-04	2.436979e-05	1.398541e-03	1.654069e-05
##	2327	2761	1348	233	4027	3299
##	5.714717e-05	1.085865e-05	1.719640e-05	1.073141e-04	9.517913e-05	1.028902e-04
##	132	6938	5598	3370	6256	5033
##	4.424786e-04	1.711194e-05	1.869102e-04	6.069411e-05	8.262311e-05	3.254621e-04
##	5525	3651	1861	5943	3749	256
##	1.135815e-05	3.237161e-07	2.352418e-07	2.774957e-04	1.915872e-05	2.785696e-06
##	3324	4812	5861	4899	2131	1508
##	9.747884e-06	3.296839e-04	1.263040e-04	1.053004e-03	6.498411e-04	1.257337e-06
##	5482	6998	4212	3971	3131	6821
##	1.180752e-04	4.205552e-05	1.779740e-04	1.689900e-05	5.487335e-05	2.096427e-05
##	6791	918	1139	4285	5219	2569
##	5.072232e-07	2.401689e-06	8.207849e-05	6.953894e-05	1.942802e-04	2.365547e-05
##	2081	5060	6123	2075	428	505
##	5.575973e-06	2.720391e-04	1.988645e-05	4.457297e-04	3.130640e-04	5.433587e-06
##	5877	563	2252	5200	2550	6676
##	1.062856e-04	1.545935e-04	1.041426e-04	1.833814e-04	1.401165e-04	2.839755e-05
##	2642	472	6314	6796	1539	2462
##	1.301180e-04	2.084945e-04	1.011034e-04	1.673886e-05	1.177525e-04	2.647864e-07
##	78	3559	1277	6451	3398	4003
##	8.412334e-05	1.010248e-04	2.320571e-05	1.007289e-05	1.337540e-05	4.765071e-06
##	5037	4060	1106	6369	1379	6993
##	1.485912e-04	1.385863e-04	2.248736e-04	1.040503e-04	7.146420e-06	2.309116e-05
##	2864	550	3670	5609	706	2707
##	1.873456e-04	2.405147e-05	2.196974e-04	4.965221e-05	1.918153e-04	1.169730e-04
##	4810	759	807	2448	549	1872
##	1.664354e-04	1.510322e-04	3.563923e-05	2.091254e-04	8.498293e-05	3.188298e-05
##	5939	821	4744	2339	4992	6246
##	2.383159e-04	1.015396e-04	6.573255e-06	2.190531e-07	1.188790e-03	1.088131e-05
##	686	712	4364	6951	1898	6917
##	1.900497e-04	8.599430e-05	1.586495e-05	1.086468e-04	1.095035e-03	2.986444e-06
##	2199	5324	6690	3110	5233	2186
##	4.510826e-05	8.449364e-05	9.691256e-05	1.468891e-06	1.415823e-04	5.064887e-04

##	1350	1662	6722	3423	845	569
##	6.674550e-06	8.296224e-05	1.802606e-05	2.062320e-06	1.032816e-04	2.612743e-04
##	3323	3801	304	1000	6924	3389
##	1.315592e-04	1.234284e-05	2.734912e-06	2.684806e-04	1.356786e-05	2.746537e-06
##	5849	4689	3314	4723	385	6911
##	3.427719e-05	1.047621e-05	1.642198e-04	7.208224e-06	1.206775e-04	1.115303e-04
##	5941	4274	5534	5272	3592	2887
##	1.612754e-05	3.112443e-04	2.224026e-04	7.408652e-05	1.088016e-04	6.084353e-05
##	87	3493	120	2616	3950	4196
##	2.319002e-05	1.341828e-04	8.273977e-05	9.730303e-06	4.137963e-05	1.950653e-05
##	2579	1445	5374	2125	6927	1560
##	2.424399e-04	2.184231e-04	3.358777e-05	1.019719e-03	1.909653e-03	1.425163e-04
##	509	6013	84	2873	6474	4551
##	1.225367e-04	1.220579e-04	1.090737e-04	4.039412e-06	9.926087e-05	3.216122e-07
##	5859	6579	5842	5415	2142	1083
##	6.309409e-07	1.450954e-04	1.118872e-02	1.910595e-03	2.213096e-05	2.056148e-04
##	3144	6500	3995	2064	5406	662
##	1.027719e-04	1.664354e-04	7.876117e-04	1.455693e-05	1.596108e-04	5.741933e-05
##	6636	2445	5522	4752	3067	2219
##	1.212006e-05	2.190306e-04	6.739431e-06	1.094998e-03	1.605115e-04	5.361833e-06
##	405	6975	882	6697	1276	3189
##	1.579610e-05	4.653639e-05	1.052468e-05	8.629894e-04	6.626927e-06	2.568217e-04
##	3828	174	2291	6502	6564	4564
##	1.408732e-04	7.330835e-04	3.097550e-04	3.937773e-05	1.510278e-04	1.303841e-04
##	5474	2429	4276	6556	2268	100
##	3.322514e-05	3.004349e-04	1.757281e-04	1.840767e-05	9.976744e-05	1.786120e-04
##	6052	5195	2939	7043	5230	4363
##	2.187910e-05	1.631355e-04	3.810902e-05	4.715080e-05	4.312466e-04	2.054550e-06
##	2165	4070	6688	1502	1336	1821
##	2.452095e-05	2.275735e-05	1.134460e-04	2.937103e-05	3.591522e-04	9.982611e-05
##	6127	1001	2932	1044	5141	2128
##	1.680861e-04	1.218473e-04	1.950354e-04	3.886402e-04	7.847631e-04	3.245279e-03
##	860	3393	645	3388	5582	2139
##	2.348758e-06	3.194910e-06	2.738440e-05	6.603762e-05	3.047817e-03	1.016289e-05
##	681	1248	1457	5915	957	3201
##	1.108775e-04	7.284387e-05	1.587951e-04	3.144914e-05	3.398826e-07	7.444596e-04
##	4270	2103	2207	1664	6066	5738
##	1.693686e-04	1.105363e-04	9.397078e-04	6.485301e-04	1.053373e-06	1.168933e-04
##	6356	2857	4215	1491	6105	6037
##	6.639765e-05	1.902725e-04	1.133540e-04	4.730339e-06	1.080456e-04	1.486505e-04
##	4128	1741	3691	38	4252	5907
##	1.371382e-06	4.317371e-06	5.957601e-04	1.742879e-05	3.093960e-05	1.440519e-04
##	1622	1646	5784	3281	3225	4506
##	2.794644e-04	4.653538e-04	1.037662e-04	7.565214e-06	1.288484e-04	3.188716e-07
##	4225	3728	5601	2899	1399	1695
##	2.373885e-07	1.045172e-04	1.311481e-04	1.292198e-04	9.051911e-05	6.664918e-04
##	2783	4056	1686	4079	3387	5756
##	3.533528e-05	4.763792e-06	3.550838e-05	2.154617e-04	7.861223e-06	4.145072e-04
##	4509	1978	2955	5904	6480	5711
##	1.405343e-05	7.153659e-05	1.332425e-04	2.658474e-05	2.084945e-04	8.162347e-05
##	5431	879	744	1628	6522	6085
##	1.295176e-04	5.666338e-06	8.267810e-07	1.460118e-04	2.143668e-05	7.170321e-05
##	5631	4062	6428	2277	6251	4296
##	3.285733e-04	4.316252e-05	3.895933e-06	9.924383e-05	2.338065e-05	3.022537e-06

##	6174	2515	6779	2204	1172	2912
##	5.763558e-05	1.938175e-04	2.160384e-07	3.641138e-05	1.107901e-03	1.183072e-04
##	4284	68	6806	3277	5323	1124
##	2.174559e-04	3.855673e-05	3.607782e-05	1.197601e-04	6.533278e-05	3.028437e-05
##	5627	5894	6407	5676	2706	6392
##	7.801463e-05	3.563722e-05	1.591127e-05	2.347818e-04	3.108503e-07	3.508366e-05
##	3704	6093	1674	1963	133	1453
##	4.902107e-05	1.225314e-05	4.202619e-04	2.619117e-04	1.988783e-06	6.006911e-06
##	5562	4487	2073	5180	4271	4345
##	1.671179e-04	1.507534e-05	4.312524e-06	1.297381e-04	1.079800e-05	6.369600e-06
##	5806	3608	2466	577	4327	5182
##	4.591329e-05	5.032985e-05	6.456289e-04	1.245491e-04	1.039255e-04	8.315322e-06
##	1440	582	6295	3401	1792	583
##	1.265922e-04	1.157577e-04	1.482930e-03	1.331928e-04	1.537376e-05	1.157526e-04
##	3756	2581	6350	6652	2782	3899
##	1.208699e-04	1.711181e-04	5.833551e-06	4.157497e-05	7.876310e-05	2.824680e-06
##	6325	2290	2492	1567	6630	5449
##	1.831251e-04	4.222160e-05	3.599751e-06	3.646370e-06	5.610460e-06	8.744325e-05
##	16	584	2437	5951	246	6850
##	1.276299e-04	1.638058e-04	4.623371e-05	1.741683e-04	2.854714e-04	4.820338e-05
##	1186	3185	5634	5848	2730	3172
##	1.656875e-04	5.719600e-06	8.435787e-05	1.924060e-05	1.100902e-04	1.535252e-05
##	1299	1693	4588	1958	1419	3550
##	3.255619e-05	5.782455e-06	7.999831e-05	1.066327e-05	1.336646e-05	6.292267e-06
##	1074	6947	6637	1390	5402	6176
##	1.157271e-04	7.369981e-06	1.188389e-04	2.416625e-04	7.999820e-06	6.664682e-05
##	5847	2746	6283	2664	3562	6387
##	3.242232e-04	1.062487e-04	1.007035e-04	1.253655e-04	2.061686e-04	5.432718e-06
##	6898	2697	5098	106	5892	192
##	9.049227e-06	9.699254e-07	8.697096e-05	9.067295e-05	4.263219e-04	1.223068e-04
##	3732	4373	2134	5471	1530	6624
##	2.635072e-04	1.661396e-04	1.237645e-04	8.671703e-06	7.301063e-07	1.143640e-04
##	4613	2353	763	1486	2287	2708
##	1.784761e-06	5.612957e-05	1.274243e-04	1.781985e-04	1.103656e-04	1.026096e-04
##	629	4977	4847	5690	1653	377
##	7.514309e-05	2.811572e-06	1.503661e-04	2.474848e-04	2.819412e-05	1.751473e-04
##	5103	2391	202	5995	2482	907
##	6.593410e-05	5.573230e-05	1.475394e-04	4.056657e-04	8.793069e-07	1.383547e-04
##	2528	2376	3491	378	927	1455
##	1.259481e-04	7.905347e-05	2.443876e-04	1.908764e-04	1.197481e-04	8.997939e-06
##	2773	1730	4891	2531	6468	5752
##	5.203278e-06	1.266098e-05	2.671778e-05	9.210133e-04	1.527583e-04	2.350655e-06
##	5276	6770	1513	15	3410	3319
##	2.235057e-04	2.164394e-06	1.996781e-04	3.312323e-04	8.880247e-05	7.886802e-04
##	4436	4640	1265	972	3820	5606
##	1.185574e-04	1.319568e-04	1.650935e-05	3.898442e-05	4.245279e-06	7.564455e-05
##	2858	3945	6179	4038	636	6158
##	1.384632e-05	4.837561e-05	1.200283e-06	1.080237e-06	1.987896e-03	1.401005e-03
##	517	3876	4026	3360	3915	2144
##	2.592307e-05	4.132127e-04	1.215867e-04	1.491218e-05	4.438294e-06	4.119852e-05
##	4483	2539	2829	2293	5749	5638
##	1.271714e-04	1.486227e-05	1.667293e-04	2.437658e-05	3.208332e-04	1.305511e-05
##	5998	6268	6684	3956	1745	3293
##	5.489329e-04	1.247693e-04	9.363128e-06	2.127356e-05	1.133541e-04	1.090589e-04

##	6041	6783	5704	4867	1525	5910
##	1.233341e-04	5.585365e-05	3.067424e-07	4.808355e-05	1.110875e-04	1.517616e-05
##	1857	4098	4989	4043	2372	39
##	1.354812e-03	2.531946e-05	1.063976e-05	1.130631e-04	1.756564e-04	2.624642e-04
##	6880	3089	2721	5576	4341	2294
##	1.158475e-04	2.057857e-05	2.995542e-04	4.881647e-06	1.087408e-04	6.192642e-06
##	1941	5296	2989	3814	792	6874
##	5.980870e-06	1.382139e-04	6.453872e-05	4.631457e-05	5.602071e-06	1.031612e-05
##	5775	5122	6672	6555	1007	866
##	1.595849e-04	4.073735e-05	4.657722e-05	1.283784e-04	1.587379e-04	1.193382e-04
##	6891	5125	3188	2161	4124	862
##	8.246235e-06	1.162479e-05	5.589295e-05	5.477052e-06	3.003963e-05	1.599260e-05
##	2173	6219	5319	3353	4945	6208
##	1.871804e-04	2.124315e-06	3.540410e-05	1.066905e-04	4.633835e-05	5.593473e-04
##	3164	3807	1704	6467	5421	3917
##	4.843669e-05	6.652238e-05	4.875451e-05	6.760558e-05	1.658689e-04	2.650255e-04
##	496	2386	5134	1773	2452	5128
##	8.219049e-04	1.329637e-04	1.875843e-04	1.156039e-04	2.150656e-04	2.694373e-03
##	138	3785	4468	2671	3207	416
##	4.981798e-07	2.646465e-04	1.411688e-05	4.080148e-05	7.421630e-05	7.805589e-05
##	3693	2766	1470	2604	3922	6615
##	2.319421e-04	8.612143e-05	3.029535e-04	1.585576e-04	3.990339e-05	2.390881e-07
##	5801	1552	1524	3554	6666	5706
##	1.131622e-04	1.647318e-05	7.128180e-05	7.296620e-07	5.173071e-06	1.651390e-04
##	210	6404	1527	1191	2489	6248
##	4.633831e-05	1.423424e-04	9.390651e-04	1.374229e-04	9.511920e-04	1.576204e-05
##	2669	5526	4844	777	3195	6044
##	1.479343e-03	1.644329e-06	3.022276e-07	1.343568e-04	2.383618e-03	4.710455e-04
##	2238	4347	4938	4118	5772	5366
##	2.283104e-05	2.051476e-05	3.667417e-05	3.414383e-05	3.384354e-05	5.978388e-07
##	6953	4575	2813	2896	2883	4906
##	6.216081e-04	4.167670e-05	1.853345e-03	5.186356e-06	8.131031e-05	8.697956e-07
##	4808	2228	1493	3294	2545	5967
##	4.387166e-04	8.578315e-07	1.448743e-04	1.533937e-04	1.726837e-04	3.738995e-04
##	1949	355	6423	1829	948	1207
##	1.134117e-04	8.036027e-04	7.337690e-06	4.668981e-06	7.194242e-05	2.403007e-04
##	3775	6673	6789	6370	5226	827
##	1.758222e-05	1.036485e-05	1.211884e-05	5.642684e-05	3.288929e-05	1.237432e-04
##	4382	3004	4294	2093	6056	2643
##	5.897121e-04	2.076845e-04	1.697861e-04	4.386393e-06	1.050525e-04	6.004902e-04
##	6277	599	2265	5483	1010	4870
##	2.451597e-05	2.604568e-05	9.329737e-05	4.370511e-04	1.338872e-05	1.310453e-04
##	2319	5697	6532	2360	2108	1631
##	2.135016e-05	4.797261e-04	3.443098e-05	2.971589e-05	7.606711e-05	1.315997e-04
##	754	4154	2584	2295	1538	5778
##	1.954842e-04	1.010487e-05	8.718583e-06	1.291037e-04	4.278098e-06	2.815792e-06
##	874	2958	5824	3046	4622	4493
##	6.693699e-03	3.750370e-04	1.388333e-05	1.437173e-05	9.879502e-05	1.602646e-06
##	1764	4552	3074	4437	218	4011
##	1.607978e-04	3.432968e-05	8.804299e-06	3.522128e-05	2.719784e-06	1.666315e-04
##	3976	111	2770	4137	5803	422
##	1.597990e-04	8.180634e-04	1.410443e-03	2.342928e-06	1.231315e-05	1.557582e-04
##	1425	2842	5208	3735	2732	6876
##	2.169159e-06	1.283466e-04	1.105621e-03	5.380783e-05	7.976843e-05	4.769891e-07

##	3136	4930	5732	5868	5528	3992
##	3.008384e-04	9.907687e-06	4.239193e-05	2.931903e-06	3.819539e-05	1.127026e-04
##	5398	5519	361	6323	6117	3206
##	1.217720e-04	2.079639e-04	8.617744e-05	1.209650e-04	1.631088e-05	1.435410e-04
##	159	3725	1654	2135	5232	2010
##	5.278647e-05	7.934269e-07	9.175993e-07	1.661396e-04	1.494561e-04	4.941956e-06
##	2597	6540	1995	3133	4384	5359
##	3.682192e-05	3.851127e-05	1.380275e-05	3.576250e-04	8.349459e-06	1.819062e-05
##	1715	2126	2471	1750	261	2343
##	5.207717e-06	5.118174e-06	4.980713e-07	1.772558e-04	4.435889e-04	2.554029e-04
##	4142	6973	3639	3029	4332	321
##	1.296467e-05	1.413808e-03	2.695697e-04	3.789589e-04	3.408865e-07	1.162125e-03
##	2380	5663	5115	685	1040	682
##	2.468228e-04	1.244287e-04	2.025033e-05	3.083619e-04	4.477865e-04	7.294958e-06
##	171	4730	294	3238	5254	6103
##	2.976893e-05	2.003677e-06	5.319604e-04	4.421324e-07	3.302292e-05	9.828300e-06
##	1084	2938	5237	6322	971	2583
##	1.124320e-04	1.674941e-05	3.841000e-05	3.514191e-03	1.027445e-04	8.386526e-04
##	2162	3111	2405	4473	5500	4798
##	1.170528e-04	1.640132e-04	5.028078e-05	6.189775e-06	1.531347e-04	1.219035e-04
##	4881	1047	939	5590	473	1697
##	1.861634e-06	1.325319e-05	8.418209e-05	2.985557e-03	1.319667e-04	1.127733e-04
##	2930	6450	1705	1924	2257	2512
##	1.022282e-05	1.649362e-04	9.343879e-05	5.157407e-06	5.812855e-05	7.856569e-05
##	3444	3532	3884	697	3468	6439
##	8.719301e-05	2.156281e-05	1.693767e-04	6.139965e-06	1.175819e-04	1.169705e-04
##	3862	6068	2885	1006	6686	6864
##	3.072969e-04	7.895843e-05	9.335135e-06	3.408636e-05	1.066186e-05	1.141871e-05
##	2718	4803	5270	4067	1968	3844
##	1.054833e-05	2.725137e-05	7.465332e-05	7.844593e-06	2.745687e-03	1.231226e-04
##	5111	4084	5306	6632	661	5805
##	1.705490e-04	1.883604e-03	2.248343e-05	2.933994e-05	1.097273e-03	3.097497e-07
##	1973	3021	3777	5292	51	528
##	1.073807e-04	1.216060e-05	1.464504e-05	8.261919e-06	3.712023e-05	2.487078e-05
##	1321	6928	1597	3875	6329	3821
##	9.095430e-05	1.513649e-04	2.685816e-04	6.473331e-05	9.448494e-06	9.022918e-05
##	4647	3070	6064	3334	4259	6594
##	3.030267e-04	4.235336e-05	2.563654e-07	3.233652e-05	5.201376e-04	4.614128e-03
##	1344	6763	1843	1076	6377	2418
##	6.018284e-06	1.192940e-03	2.333044e-05	2.684056e-05	3.885084e-07	5.473313e-05
##	3271	1565	3109	1787	3812	5493
##	1.164548e-03	1.392378e-04	1.294395e-04	3.349458e-04	1.682633e-04	6.036114e-07
##	4209	1666	6524	6560	3760	3855
##	2.528628e-06	1.941638e-04	3.821445e-05	4.659053e-05	1.241706e-04	1.390739e-04
##	2069	296	4890	3918	3739	5429
##	6.581204e-05	1.663370e-04	2.381219e-04	1.271945e-04	1.813006e-05	1.258357e-04
##	6517	5322	2200	6952	4756	3255
##	2.883353e-04	4.659309e-05	2.065721e-06	1.959505e-06	6.775327e-05	4.715341e-04
##	2760	3993	651	27	1536	1731
##	1.651390e-04	6.634111e-06	1.285811e-04	5.386663e-04	1.209123e-04	1.676734e-04
##	3579	4133	4637	3980	3119	5654
##	2.111229e-05	1.104618e-03	3.039889e-06	5.521731e-07	2.966719e-06	1.304456e-04
##	6710	981	3160	5260	1707	3363
##	5.984860e-05	1.570267e-05	8.938946e-04	4.006795e-05	1.947586e-05	2.095291e-04

##	1822	6667	700	6922	6683	3163
##	2.722443e-04	6.042784e-05	2.542154e-06	1.425769e-05	1.255190e-05	4.911566e-05
##	1726	6608	6422	627	1480	5367
##	2.907862e-04	1.118810e-03	4.817555e-05	8.522021e-05	1.002875e-05	3.102117e-06
##	4655	2638	5666	2444	5399	1660
##	3.423491e-06	1.227070e-05	7.982674e-06	6.478441e-05	1.406157e-04	4.094204e-06
##	3534	3320	603	4537	3311	2178
##	4.230218e-05	1.248577e-04	5.555559e-06	1.265623e-04	1.122761e-04	3.367067e-05
##	2500	3597	1322	876	6980	5430
##	2.154423e-05	2.013947e-04	6.361399e-06	1.385338e-04	1.733856e-04	4.459355e-06
##	330	3488	1865	1027	2169	3847
##	1.261613e-04	1.525656e-06	3.103922e-05	1.178648e-04	1.282671e-04	7.652942e-05
##	6006	4202	5737	3683	5909	6180
##	7.409771e-06	2.135322e-07	1.659412e-04	1.271945e-04	1.447338e-03	1.421811e-04
##	2612	1396	3946	2236	3833	2648
##	1.344114e-04	7.690807e-04	6.787664e-04	2.581703e-05	1.678194e-05	1.412553e-04
##	5427	5432	342	180	447	5610
##	1.412701e-05	5.207910e-06	6.737778e-06	6.805446e-07	1.260692e-04	2.681806e-04
##	419	1757	4425	4369	3027	761
##	1.676617e-04	2.141277e-05	1.151278e-03	1.289750e-04	1.468729e-04	1.674070e-04
##	4725	1284	1200	5727	3073	4103
##	1.730127e-05	3.758821e-05	1.026439e-04	2.499519e-06	9.337532e-06	8.408816e-05
##	5872	2676	2786	5250	7040	1427
##	4.536570e-04	3.716067e-06	4.219403e-04	2.761288e-06	2.827767e-05	1.053040e-05
##	1086	5041	6186	1343	1521	683
##	1.461610e-04	2.877971e-04	8.855245e-05	5.492462e-05	1.189935e-04	1.909255e-04
##	6023	80	6393	5974	224	6160
##	1.553327e-05	3.680232e-06	3.274881e-06	5.231699e-05	2.568730e-04	1.415288e-04
##	2862	6852	5222	5940	75	6070
##	1.092969e-04	6.376048e-05	7.550927e-05	2.652095e-05	1.898287e-04	9.531225e-06
##	512	4442	2984	265	2478	6785
##	5.943470e-05	3.610717e-06	8.944799e-06	2.324391e-04	5.699307e-04	1.972144e-05
##	1209	1372	699	4127	1612	17
##	1.106654e-04	1.115798e-04	2.374404e-05	7.495535e-05	8.562068e-06	1.592291e-06
##	1008	3116	6486	4566	1866	1729
##	1.292401e-04	1.486939e-04	6.030670e-06	2.852782e-06	5.666214e-05	2.454956e-05
##	6253	3519	3050	4371	4370	5870
##	4.658685e-06	1.647326e-04	1.401748e-03	8.221155e-05	1.088958e-03	5.017552e-05
##	1488	3530	5140	182	135	4165
##	8.587040e-05	3.237368e-04	2.350816e-06	1.875476e-04	3.680922e-04	7.121516e-05
##	5126	6220	2225	1490	3390	4915
##	1.307781e-04	1.095636e-03	1.714004e-04	3.501525e-05	3.017198e-04	3.507710e-06
##	4100	2027	6629	5922	1885	6719
##	8.331926e-05	3.768263e-05	6.644094e-04	5.060548e-05	2.880140e-05	1.216115e-04
##	1867	6669	1370	5593	5376	2918
##	5.408485e-05	1.367822e-04	2.484530e-05	2.955022e-05	2.599249e-04	3.296341e-07
##	6426	1834	4063	2828	2929	6055
##	5.051830e-06	1.886694e-04	1.238736e-04	1.902725e-04	1.911199e-05	2.713878e-04
##	24	3895	1568	2215	4515	1009
##	5.835669e-06	2.076994e-04	1.038569e-04	1.498176e-04	5.129072e-05	2.280600e-04
##	4885	6914	4617	1444	4410	1617
##	5.444643e-05	6.721542e-05	3.403746e-05	1.522364e-04	1.089192e-06	1.333440e-06
##	4233	1877	1458	5117	6385	2534
##	1.251159e-04	4.566968e-05	1.781585e-04	1.240938e-04	4.203202e-05	2.023425e-06

##	2118	5858	179	3652	3504	5130
##	2.421671e-06	1.611625e-04	6.874140e-04	2.617834e-07	4.530341e-05	1.872345e-04
##	5992	2809	5285	3660	719	3368
##	1.556580e-04	1.105348e-03	3.211671e-04	8.239795e-05	2.717332e-05	2.334328e-05
##	6240	6717	2427	3359	305	6655
##	2.232634e-05	1.213391e-04	2.871718e-05	2.655002e-05	3.123937e-05	1.285455e-04
##	5223	4605	5810	952	1902	1016
##	1.145261e-04	2.921652e-05	4.417099e-04	2.023474e-04	3.360628e-05	2.291555e-04
##	1330	2308	1398	4310	1303	1469
##	2.114811e-07	1.026483e-04	4.370299e-04	3.129768e-05	2.533828e-05	1.753383e-05
##	2078	5050	62	3555	2472	4944
##	1.221002e-04	1.447338e-03	1.665851e-05	1.669962e-04	7.301925e-04	6.066957e-06
##	1713	3117	5959	4009	110	6102
##	2.578500e-05	3.296877e-05	5.999361e-05	8.400791e-06	2.115975e-07	6.935827e-05
##	6213	6035	5305	1239	2563	5826
##	4.254588e-05	6.406518e-05	9.418759e-05	1.528420e-04	2.091527e-06	1.243164e-04
##	4189	2667	5434	4682	6520	3250
##	2.031895e-04	6.799770e-06	5.213047e-05	1.277754e-04	1.547751e-05	6.676435e-05
##	6916	2613	3327	2956	4235	4778
##	1.435321e-05	1.492770e-04	9.604252e-04	1.247785e-04	2.150566e-05	1.683236e-04
##	5564	1953	3700	856	266	1727
##	1.031323e-04	2.455899e-04	2.948872e-05	1.534648e-03	1.446142e-05	2.379880e-05
##	5658	6362	5935	3643	3846	4524
##	2.800100e-04	1.132920e-04	1.969850e-04	2.125247e-04	1.247165e-04	1.606169e-04
##	3650	5349	3581	4082	3233	3908
##	3.373115e-07	2.267644e-05	1.338973e-04	1.259477e-04	1.905331e-05	1.866710e-04
##	1989	10	4335	6755	156	1459
##	1.271044e-03	3.747256e-06	1.534233e-04	2.512767e-04	1.528174e-04	1.422789e-03
##	5079	4269	1767	2871	6446	1520
##	2.753343e-05	5.249457e-05	1.026856e-05	8.200220e-05	6.771719e-04	4.059266e-04
##	3926	6342	3593	6153	5064	328
##	2.716216e-05	1.324033e-04	3.491512e-04	1.415941e-04	1.442085e-04	1.258337e-04
##	262	6432	250	4048	5747	1113
##	1.326443e-04	1.970929e-05	8.244423e-05	1.785814e-05	1.330798e-04	8.413901e-06
##	5611	4557	1874	6116	4825	3527
##	1.204952e-04	1.322085e-04	3.097632e-06	6.234974e-05	1.762120e-05	2.518748e-04
##	1769	1304	121	4008	316	831
##	4.075242e-06	2.927364e-07	4.185846e-05	1.575615e-06	1.698462e-04	8.899257e-04
##	158	4006	3587	2230	4508	1407
##	1.411782e-05	1.193618e-03	4.653471e-04	2.209437e-04	1.171059e-04	5.521177e-07
##	1067	2044	3007	6045	3878	5053
##	2.293237e-06	7.203539e-05	1.466472e-04	1.438034e-04	3.879427e-04	3.398510e-05
##	3620	1102	1985	2933	5983	6442
##	5.972145e-06	1.596131e-05	1.481687e-04	2.115410e-04	2.403487e-05	4.017815e-05
##	1897	6757	2021	1323	4950	3544
##	2.483339e-05	1.424613e-04	1.452663e-05	4.205557e-05	2.555391e-04	3.929720e-05
##	4224	833	3143	6960	5600	4763
##	2.429096e-04	4.024534e-06	1.475763e-03	4.473930e-05	1.245670e-04	3.160347e-05
##	2014	4158	3925	2751	3081	1035
##	7.996453e-06	5.236684e-05	6.997886e-04	1.207719e-04	1.463055e-04	5.293847e-06
##	5926	750	5314	2557	3547	213
##	4.604083e-05	1.496073e-05	1.965075e-05	2.745272e-05	5.807802e-06	6.534609e-07
##	2479	3702	5071	3208	6614	5419
##	1.298492e-04	1.154734e-05	2.738491e-04	8.650193e-05	1.210724e-04	1.098970e-04

##	2406	415	1494	2925	691	4434
##	1.229905e-04	1.391790e-05	1.988226e-04	1.359973e-04	1.667293e-04	2.886132e-04
##	5011	3655	1601	530	694	5265
##	1.420262e-05	9.188675e-05	1.041625e-04	5.094699e-05	1.183400e-04	5.326422e-07
##	1232	1920	3668	6700	2122	6184
##	3.727841e-05	2.584964e-04	1.942573e-04	1.321057e-06	1.667293e-04	1.329918e-05
##	4004	1703	333	5475	3418	989
##	4.937490e-06	1.651354e-04	4.536145e-05	6.119552e-04	8.270840e-05	9.759464e-06
##	1701	6971	5337	6716	7000	2801
##	2.423099e-06	1.255439e-04	1.640132e-04	3.515085e-04	6.128430e-04	1.609545e-05
##	3381	3275	6466	2814	302	5683
##	9.856594e-05	1.890225e-04	8.205646e-07	4.344553e-07	1.083310e-04	1.845742e-04
##	3192	5339	1219	5832	6113	6742
##	4.009658e-05	1.517105e-05	1.613780e-04	1.318271e-04	4.813160e-05	1.515757e-04
##	5553	1446	4678	2196	3439	1341
##	1.393176e-05	2.971506e-04	1.287842e-04	1.202255e-05	1.605400e-04	2.272954e-04
##	1465	5065	6421	2133	798	297
##	1.004318e-04	4.663669e-04	3.517991e-05	1.297597e-05	1.890027e-05	4.049947e-06
##	4896	353	6824	5834	1384	3962
##	2.904231e-05	5.066608e-04	1.324814e-04	2.574111e-05	2.725038e-04	6.352257e-05
##	96	3307	6445	677	5617	6264
##	1.415793e-04	4.027705e-04	2.297464e-04	2.718996e-06	1.772669e-05	2.706464e-05
##	797	4999	1154	594	5455	6634
##	4.385981e-05	1.457420e-04	9.972311e-06	5.963245e-05	1.260692e-04	1.168299e-04
##	1220	6196	3787	2240	3203	4435
##	6.563057e-06	1.250645e-04	5.306468e-05	8.865442e-07	1.981144e-04	2.664224e-04
##	1133	2632	1105	6152	3008	2361
##	1.275861e-04	1.204272e-04	3.459004e-06	1.322252e-04	4.521409e-04	5.991331e-07
##	1814	4190	4958	3079	5443	3889
##	3.793321e-04	4.593167e-06	2.970066e-05	1.086865e-04	8.796157e-07	1.107499e-04
##	5626	2469	6042	1333	3872	2872
##	1.415407e-05	2.848307e-04	8.845031e-05	3.783007e-07	9.942576e-05	1.407847e-04
##	1031	855	2260	2234	1011	4740
##	1.296642e-05	3.400267e-07	5.641295e-05	1.006822e-05	1.469472e-04	1.758690e-04
##	5809	5862	3042	3343	2575	3032
##	5.127878e-05	5.787269e-06	1.900497e-04	1.889872e-05	3.101010e-04	1.738588e-03
##	3722	5304	6390	3499	7034	339
##	1.375470e-03	7.603282e-06	8.602093e-07	8.262161e-04	2.506620e-05	7.457751e-05
##	3218	3979	2547	4850	3016	2194
##	1.421733e-04	7.462455e-04	4.399512e-05	1.410477e-05	1.441505e-05	1.124550e-06
##	3345	3682	4470	6545	3397	1032
##	1.279881e-04	5.037264e-04	2.699130e-05	3.920502e-04	4.271858e-05	3.732028e-05
##	5789	1797	1230	4143	1167	4735
##	1.092556e-04	5.428305e-05	7.654961e-06	3.175212e-06	1.175734e-04	4.249124e-04
##	4603	710	6242	1652	4827	1391
##	5.245128e-07	5.501370e-05	2.828165e-04	1.116703e-04	1.139636e-04	2.856046e-06
##	5762	915	2307	3508	518	6177
##	5.332896e-06	3.029922e-07	2.371507e-04	1.020012e-04	1.948886e-04	6.640813e-04
##	6574	3104	6234	3455	6262	1766
##	1.088912e-05	1.500958e-03	1.206175e-04	1.592121e-05	6.128604e-07	1.517686e-04
##	3347	7021	6244	3429	3094	3394
##	5.455176e-04	3.272392e-05	5.429328e-06	6.515232e-04	2.692994e-05	1.090088e-04
##	1905	3656	220	3107	1418	2273
##	8.828374e-04	7.122371e-06	2.583437e-04	1.747855e-06	3.529672e-05	1.900065e-04

##	5031	457	604	2040	5597	4446
##	1.172283e-04	1.039975e-04	1.398938e-04	1.812916e-04	6.535468e-07	2.851578e-05
##	6053	966	3326	332	5007	3518
##	2.841983e-05	1.166457e-04	1.170194e-04	5.547194e-05	2.305754e-04	2.420375e-03
##	1591	5313	1798	3013	278	2586
##	5.208530e-07	2.535802e-04	8.198598e-06	9.367061e-06	4.268938e-05	5.017622e-06
##	2487	59	976	5990	6198	4312
##	9.025964e-05	7.806839e-06	2.421844e-03	1.071281e-04	3.324639e-04	4.493738e-04
##	2580	6388	2513	6496	7036	4251
##	2.176356e-06	2.458535e-05	3.631100e-05	1.258268e-04	8.611459e-05	5.508685e-05
##	5147	4610	2971	1657	5740	990
##	3.021261e-04	2.684855e-05	1.311423e-04	2.542062e-05	4.205939e-05	6.286986e-06
##	4635	4957	6773	2309	1952	705
##	1.413909e-04	1.269658e-04	1.165173e-03	3.263031e-05	4.375352e-05	1.277050e-04
##	4843	2278	4426	5139	1002	3309
##	2.079304e-04	1.780456e-03	7.766474e-05	5.114844e-05	3.348015e-04	2.731974e-05
##	6297	1023	6593	4819	172	229
##	2.162630e-05	4.522169e-04	3.282507e-05	8.202474e-06	8.845265e-05	7.279779e-05
##	2160	4277	2379	6519	970	6092
##	2.714628e-05	2.781341e-04	6.281967e-04	3.564263e-04	1.030813e-04	1.107433e-04
##	1423	2400	5196	3436	3054	3244
##	1.032667e-04	5.056229e-05	3.705236e-06	2.821520e-04	4.435461e-05	2.850213e-05
##	6084	4833	6565	899	4986	4458
##	6.370692e-07	3.399838e-05	8.717354e-05	1.450710e-04	5.343911e-06	6.341422e-05
##	7038	3297	6106	3318	4150	2459
##	2.362143e-07	2.620716e-05	1.039114e-03	6.034914e-06	1.042354e-02	8.627289e-05
##	5961	2226	4131	2202	6144	6777
##	1.154324e-05	1.427027e-05	5.413349e-05	4.468794e-05	1.880581e-06	9.309912e-06
##	1634	6640	5167	4645	2239	4305
##	1.871447e-04	8.704642e-05	5.761975e-05	4.727325e-05	1.103200e-03	1.889173e-06
##	2602	5734	1887	5045	4527	4453
##	1.863490e-05	2.413269e-07	3.075421e-06	4.031651e-04	1.075560e-04	7.250817e-06
##	1439	2476	3565	91	6587	1900
##	1.400749e-05	5.774674e-05	1.530137e-05	4.294778e-05	3.455283e-06	2.261075e-04
##	713	4359	4974	1940	2477	6903
##	1.128729e-06	6.614485e-05	3.910887e-04	1.678842e-04	7.063533e-06	8.220937e-06
##	1716	2823	4589	1126	6987	6985
##	2.448491e-06	4.995674e-04	9.029196e-05	3.825014e-04	2.117383e-04	9.586218e-06
##	3851	2163	6529	3122	2901	3776
##	2.031620e-05	1.390213e-04	2.753042e-07	2.026655e-04	1.268131e-04	3.766962e-04
##	4462	6181	6659	709	4338	4113
##	1.155034e-04	2.874929e-05	2.411543e-04	3.527958e-05	1.921486e-05	3.157069e-05
##	3463	26	4746	2920	4096	1129
##	1.254636e-04	2.933329e-05	1.238221e-04	7.863991e-06	4.643310e-04	9.903946e-06
##	4272	5028	2659	2778	6956	4947
##	9.550424e-06	1.351048e-04	2.578975e-05	4.201023e-05	4.751992e-05	1.174596e-04
##	3604	5986	5567	235	1380	5048
##	3.361694e-04	9.619407e-06	5.088159e-06	1.108422e-05	1.112652e-06	2.910482e-05
##	6576	4861	2455	5293	6503	4972
##	3.704734e-05	4.247781e-05	3.221771e-07	4.997997e-06	1.398689e-05	1.834177e-05
##	6137	1484	5210	4757	3740	1375
##	2.621869e-06	1.279135e-05	6.332624e-05	3.883690e-05	1.437053e-05	2.492826e-05
##	740	5310	1780	3842	4379	714
##	9.100674e-06	6.664415e-07	8.133421e-04	2.703050e-04	3.852986e-07	2.258404e-04

##	1579	7025	4016	264	6391	2370
##	1.679878e-04	2.936724e-05	2.077076e-05	2.219666e-05	5.001189e-05	3.631478e-05
##	3784	6944	6804	1499	1468	1388
##	5.126445e-05	8.454754e-04	3.957879e-05	1.449735e-04	4.618229e-05	2.873394e-07
##	3969	6175	2423	1839	2876	3100
##	2.204004e-07	8.289114e-04	2.947220e-04	2.266758e-05	1.693704e-04	2.025367e-05
##	6239	3234	3	433	3292	3870
##	1.258795e-05	1.141255e-04	2.188089e-04	1.730922e-04	3.073457e-05	4.731907e-05
##	3726	5880	6340	7030	5761	2844
##	1.232280e-04	2.550986e-05	2.732685e-04	9.318629e-05	2.565684e-04	1.504176e-06
##	2303	6229	1808	1992	1645	5701
##	1.020284e-05	2.819029e-06	1.144789e-04	2.084250e-05	2.681218e-04	3.947634e-05
##	123	3873	369	64	4785	398
##	1.209522e-04	9.092684e-04	1.857060e-05	3.782800e-05	1.649362e-04	4.345005e-04
##	6065	2038	2743	5742	671	2601
##	3.564263e-04	3.017198e-04	4.626022e-06	1.565044e-04	1.385240e-06	2.953451e-04
##	893	3157	5785	456	6866	5916
##	4.028430e-05	1.117422e-05	6.786692e-05	3.239989e-04	1.142606e-04	2.826011e-07
##	1689	4472	4807	1644	4279	2393
##	4.182589e-06	5.516156e-04	3.542264e-07	4.875364e-05	4.934000e-05	1.807139e-04
##	2992	2804	6225	1254	2635	1916
##	4.782575e-05	3.276402e-06	1.928306e-05	1.306301e-04	1.071674e-04	2.721583e-05
##	5931	1097	5511	5816	4244	3601
##	5.829694e-06	3.023021e-04	4.314432e-04	1.342984e-04	2.245490e-05	9.447412e-04
##	2738	5736	3178	3174	2973	6846
##	6.670264e-05	2.176167e-06	1.143277e-06	1.977726e-05	2.580941e-06	1.877285e-04
##	4302	6167	3372	5835	1034	945
##	3.967682e-07	2.271559e-04	1.296830e-03	5.876924e-05	7.420307e-07	7.716421e-05
##	6695	226	5	3751	654	3465
##	1.994690e-04	2.619358e-05	1.248517e-04	1.678267e-04	2.290914e-05	4.578944e-05
##	6566	4696	2396	2363	6077	6463
##	6.383829e-05	6.253129e-06	7.182587e-05	5.208445e-06	3.792315e-06	1.040917e-04
##	2780	3416	6162	5390	5170	6612
##	1.330631e-04	2.071169e-03	1.993459e-04	1.166159e-05	5.887932e-05	3.629379e-05
##	5325	3478	6758	4728	6424	769
##	3.290631e-05	7.063185e-05	3.023037e-03	7.488813e-07	2.855092e-07	2.260476e-05
##	3724	6715	427	4734	4072	4243
##	1.883536e-05	6.076500e-04	8.081519e-05	2.491563e-04	3.240147e-05	1.653409e-04
##	4385	612	482	4292	5622	2116
##	1.136351e-04	1.439900e-04	4.805714e-03	9.439468e-05	1.206145e-04	2.136208e-04
##	1880	5054	3947	3124	2863	1523
##	1.248842e-04	1.224073e-04	1.765084e-04	6.236509e-05	1.366928e-04	4.106373e-04
##	5921	1413	5289	426	1553	1535
##	5.582974e-05	1.404727e-04	1.111800e-04	5.414314e-06	4.421155e-05	2.942942e-07
##	5530	733	3308	4601	6043	4362
##	1.416338e-04	4.732412e-05	1.875194e-05	2.724120e-04	5.095425e-06	2.838591e-05
##	1586	2817	4626	5194	1807	300
##	2.607296e-05	8.867408e-05	1.774679e-04	3.266004e-07	6.928489e-06	1.181521e-04
##	6899	6359	5005	1196	2267	2350
##	3.002830e-04	4.586532e-06	9.269710e-05	3.551505e-05	8.866831e-05	8.697425e-06
##	6523	6887	3906	3838	4248	5148
##	6.199414e-06	1.218247e-04	6.233111e-04	9.506726e-05	4.700260e-05	1.410040e-05
##	3773	5644	2481	3644	2832	5261
##	9.866644e-05	1.150104e-04	1.066832e-03	1.327125e-06	1.539925e-04	6.357072e-05

##	967	6547	4263	5889	2434	6689
##	1.303080e-03	2.710701e-05	1.361868e-04	5.911902e-04	6.894228e-05	3.303005e-05
##	3648	3927	3602	3503	2747	1260
##	1.390367e-04	4.730872e-05	1.163316e-06	1.205198e-05	8.056526e-06	4.756404e-04
##	2793	5316	894	6642	6962	2633
##	3.971824e-05	3.501804e-04	1.160254e-03	3.547327e-04	2.361759e-04	8.370730e-06
##	3606	494	7035	4627	717	2074
##	1.838132e-05	5.505136e-06	1.852694e-03	1.336590e-05	1.946303e-06	2.660650e-05
##	2985	3859	926	4528	414	4188
##	1.339569e-05	2.578177e-05	3.767865e-05	4.156832e-04	2.208425e-05	5.667693e-06
##	6816	2506	5769	835	1849	5509
##	2.878647e-06	6.457559e-06	3.606064e-05	1.218957e-04	4.640263e-06	3.658716e-07
##	4996	3181	1706	5612	6902	4174
##	1.262547e-04	1.206557e-04	2.224922e-05	4.073263e-05	3.421452e-05	2.678420e-04
##	5185	1145	1157	574	3492	4858
##	7.525610e-06	6.344904e-04	1.295900e-06	9.297019e-04	1.725003e-05	1.850398e-05
##	2508	4117	9	2341	4354	4206
##	3.201212e-07	1.585025e-05	2.019846e-04	6.857453e-06	1.162824e-04	6.240188e-05
##	1026	36	5463	3129	6964	4381
##	1.248048e-04	2.204266e-05	5.481311e-06	9.002642e-05	9.159504e-04	1.949410e-04
##	2733	6549	452	5942	676	6020
##	1.045780e-04	2.503684e-05	4.485775e-05	1.036650e-05	1.071375e-04	2.826353e-05
##	2229	367	460	2627	883	551
##	4.058369e-05	3.311793e-05	3.718895e-04	3.503555e-06	1.241354e-04	7.304103e-05
##	6349	4928	5828	4538	6794	2681
##	3.655225e-05	7.884080e-06	5.665092e-05	3.629463e-05	5.406049e-05	6.431058e-06
##	5497	2159	5401	1620	2282	5274
##	3.994974e-06	1.429066e-05	2.712269e-05	6.046392e-06	1.787176e-04	3.015304e-07
##	3580	49	6616	2771	3168	1197
##	2.782710e-05	1.526864e-05	6.964546e-05	1.648302e-04	6.330737e-06	8.822657e-06
##	3662	872	3701	444	610	6501
##	2.231978e-05	3.578439e-05	1.869596e-03	4.741299e-05	1.713723e-03	2.251847e-05
##	1930	5844	695	4590	2921	4320
##	5.058229e-04	3.834186e-05	1.407274e-05	4.321136e-05	5.926213e-06	9.294277e-05
##	3675	4805	6195	4663	248	5887
##	3.460838e-04	3.341243e-04	7.115544e-06	1.406963e-05	1.571747e-04	2.318730e-06
##	6427	1428	5969	1307	2777	968
##	1.346130e-05	2.313711e-05	1.416436e-04	3.328759e-03	1.545877e-04	1.212393e-04
##	2197	2991	2850	5321	849	3574
##	1.731927e-05	6.279304e-04	3.341915e-05	2.136905e-05	1.058040e-05	9.381890e-06
##	3257	194	1177	1135	2216	1774
##	1.167004e-05	8.566834e-05	9.663403e-05	6.640993e-05	1.469221e-06	3.175089e-07
##	3536	3911	4773	2286	6395	5158
##	6.724344e-05	6.504894e-04	2.360509e-06	7.457507e-04	8.827084e-05	6.042801e-05
##	4147	1816	5798	6752	268	5358
##	4.909841e-04	2.266155e-07	1.708903e-04	1.496060e-06	4.948214e-04	7.198316e-07
##	4471	5693	591	6981	6740	3538
##	8.311832e-05	7.218499e-05	8.759941e-05	5.945943e-04	1.379640e-04	2.845606e-05
##	6784	2037	5379	1326	2593	3774
##	3.034913e-05	3.576250e-04	9.815927e-06	1.268131e-04	3.298381e-05	1.124661e-03
##	4208	3023	1477	3373	3497	5150
##	2.577254e-05	1.407179e-04	1.409260e-04	6.768252e-05	4.043586e-05	5.732952e-07
##	2486	1092	3632	3252	4107	4946
##	1.539253e-04	3.633021e-05	2.786998e-04	3.284058e-04	1.747349e-04	1.603206e-05

##	5981	5051	4323	5404	348	5972
##	1.070243e-04	1.905241e-03	2.662955e-04	1.877709e-05	2.607728e-07	4.025220e-07
##	6115	1255	3066	4866	4168	3706
##	1.198371e-04	1.972082e-05	1.877111e-04	8.561654e-05	1.485235e-05	2.784220e-06
##	3229	2330	4699	5592	65	412
##	8.743809e-05	2.836949e-05	2.195878e-03	1.135210e-04	1.281529e-04	3.255788e-06
##	6433	6400	3425	4922	5962	6949
##	2.382013e-05	1.030984e-05	1.387457e-04	8.689778e-05	1.850078e-04	8.087853e-05
##	2501	3227	3813	370	471	2318
##	1.363984e-05	6.513252e-05	1.998507e-05	9.590847e-05	2.050967e-05	2.620446e-06
##	3186	5075	3642	3061	2082	4344
##	1.133481e-03	1.941388e-06	1.530787e-05	2.027292e-05	5.612841e-05	1.300950e-04
##	4754	3570	1512	6001	4988	1650
##	1.207981e-04	2.011217e-05	3.478734e-07	1.517577e-06	3.200397e-07	3.130760e-05
##	3333	3966	1796	1891	5804	1450
##	3.360755e-04	1.148551e-04	1.509952e-04	1.391668e-03	1.206026e-04	7.366812e-05
##	453	5118	327	4246	4764	7015
##	5.209611e-06	3.211850e-06	2.393318e-04	5.320107e-07	2.276655e-05	3.818132e-05
##	1117	2283	5360	4035	1871	5340
##	5.878777e-06	1.937922e-03	7.909106e-04	7.345693e-05	1.876271e-04	6.008421e-05
##	6633	6861	6839	1088	773	6120
##	6.627685e-04	3.067218e-04	1.379412e-04	5.829065e-05	1.468619e-03	4.399925e-05
##	5795	5642	2185	4941	4474	2784
##	6.872129e-05	5.829437e-06	1.077913e-04	8.064830e-05	1.826833e-04	4.830882e-05
##	6299	6961	2369	1429	1555	2906
##	2.023041e-05	5.410450e-05	1.795601e-04	2.650091e-04	1.129200e-05	6.949689e-05
##	331	4383	5480	6182	4510	5279
##	5.865300e-06	1.232810e-04	1.207919e-04	4.261046e-05	1.075344e-04	1.009699e-04
##	1310	373	1569	1059	3641	4029
##	1.520183e-04	2.049026e-05	1.249173e-03	1.066633e-04	2.082762e-04	1.148302e-04
##	4268	6479	3694	2776	2762	280
##	9.319774e-06	1.242696e-04	2.462617e-05	3.064994e-03	6.053627e-04	1.105505e-04
##	3599	4304	3904	2677	6079	628
##	1.878938e-04	3.687447e-06	1.489878e-05	8.986402e-06	2.122533e-05	4.394329e-05
##	6249	2052	983	4901	4845	1613
##	5.361087e-06	2.875839e-07	1.367903e-05	3.216819e-04	5.259497e-06	1.738695e-03
##	6531	6649	2399	3681	4308	186
##	1.330858e-06	1.601652e-05	1.560041e-04	4.282247e-04	2.802140e-04	1.148297e-03
##	885	1506	3977	5938	5628	144
##	4.303667e-06	1.165533e-04	1.077496e-03	1.368134e-04	2.089559e-04	9.605226e-06
##	1325	5514	3383	4283	4749	2385
##	1.324193e-03	1.310054e-05	3.090970e-07	6.284064e-05	1.402761e-05	3.098671e-05
##	746	3442	1901	4156	2679	2338
##	6.778413e-05	2.525731e-05	1.019609e-04	1.634738e-04	8.188407e-06	8.395488e-04
##	857	2292	6769	5311	6795	580
##	6.404346e-06	1.187450e-04	2.118465e-04	1.744173e-05	3.180555e-06	1.403828e-04
##	5970	567	2690	3259	963	1939
##	5.950253e-05	5.353896e-04	1.339493e-04	1.737018e-04	9.814084e-05	1.675986e-04
##	6945	3480	1844	4380	730	1781
##	1.180679e-04	3.450903e-04	2.388879e-07	1.009407e-05	5.907754e-06	1.583702e-03
##	3874	5258	6764	1976	3631	2498
##	3.395676e-06	2.903975e-04	3.625859e-06	1.480289e-05	1.293298e-03	1.036277e-04
##	140	193	387	3142	977	3830
##	1.239834e-04	2.938012e-07	9.355966e-04	1.033212e-04	1.252327e-04	4.178254e-04

##	6257	4461	1627	3466	5936	1381
##	6.531489e-04	8.558799e-05	3.709916e-05	1.260988e-04	5.653414e-05	3.618936e-05
##	150	1245	6849	5659	5393	6514
##	6.918738e-05	1.431224e-03	2.549151e-04	1.455855e-04	1.606370e-06	4.976301e-05
##	3800	5410	1739	1675	6456	2269
##	5.879392e-04	1.956892e-04	1.326447e-05	1.531831e-05	2.811143e-06	4.267888e-06
##	5779	6558	6799	6061	157	4441
##	1.664354e-04	1.276306e-04	8.905653e-05	3.967004e-04	9.774948e-05	1.622147e-05
##	5386	2630	1510	6358	1025	5142
##	8.954028e-04	1.251071e-04	1.518071e-04	1.533099e-03	2.765259e-05	8.559386e-05
##	6190	3658	4809	5109	1069	3928
##	9.558804e-06	6.320028e-06	1.495658e-05	3.049002e-05	5.845389e-04	1.338313e-03
##	1279	1075	4505	1805	6412	6211
##	2.148140e-05	1.679790e-04	5.164030e-06	6.579276e-06	2.666173e-04	3.341508e-05
##	2658	237	1802	1596	4350	2834
##	3.229487e-05	4.984664e-05	4.871458e-05	1.180658e-04	1.106234e-04	3.361005e-06
##	3781	1610	632	4204	6699	2816
##	6.002616e-06	1.877836e-04	1.186675e-05	6.198519e-05	4.272640e-05	1.119775e-04
##	6580	3989	851	1028	2055	382
##	5.635270e-06	1.750008e-05	1.606943e-04	4.711377e-05	2.792422e-04	2.620877e-04
##	6518	6807	3793	6809	4449	668
##	1.062732e-04	3.958176e-06	1.897909e-04	9.047889e-05	2.152687e-04	3.354714e-06
##	4831	2692	3897	4521	2626	3395
##	1.117717e-05	9.951395e-05	4.927940e-06	1.465057e-03	1.653722e-05	3.319863e-05
##	4094	1386	1818	4995	1195	4226
##	3.964930e-05	7.794545e-05	1.560453e-05	1.563114e-04	4.319295e-05	5.590610e-05
##	2322	6383	3509	693	4169	1366
##	1.970265e-05	2.711847e-05	1.145566e-04	2.402519e-06	5.155054e-06	8.942233e-03
##	2022	6255	3288	900	5924	98
##	9.981078e-05	2.544123e-05	1.655847e-04	4.156494e-05	5.514589e-04	1.265098e-03
##	292	2739	58	6837	1125	5705
##	2.714767e-05	2.163336e-05	6.850468e-05	1.220133e-04	4.993201e-05	1.601232e-04
##	2056	5344	2168	1298	2895	6602
##	1.742667e-04	1.181003e-05	1.427867e-04	2.604043e-04	2.418413e-03	6.600479e-05
##	921	2441	1608	5156	3253	325
##	9.131437e-07	7.058180e-06	1.415144e-04	1.150629e-04	4.432135e-05	2.474487e-06
##	5032	1225	5589	4291	1108	1505
##	8.557050e-04	3.450681e-04	2.771339e-04	4.854485e-04	3.867020e-07	6.380887e-05
##	2752	3371	5056	2705	2538	4200
##	1.993523e-05	5.780919e-06	1.849678e-06	8.270752e-06	1.032843e-04	9.581472e-04
##	6067	6185	2754	652	5035	2606
##	1.036434e-04	1.628007e-05	9.800589e-05	1.166909e-04	3.605978e-06	2.982144e-05
##	5886	1519	272	6319	1800	2719
##	1.525387e-05	8.763796e-05	6.207334e-06	3.360297e-05	1.307515e-04	2.190852e-06
##	3986	6577	6920	469	1443	984
##	4.254583e-05	1.417439e-04	2.157020e-05	3.016378e-06	5.675905e-05	1.058411e-04
##	2594	7	2781	3006	5596	2325
##	6.071804e-07	1.334832e-04	2.266824e-04	1.251136e-05	1.437763e-04	1.447552e-04
##	2647	3818	4140	2241	2366	1714
##	1.385522e-05	1.418264e-06	5.638484e-05	7.937871e-06	2.555817e-04	9.605449e-06
##	5863	3522	7020	236	4639	1932
##	6.651264e-05	4.975134e-06	4.457549e-06	2.136827e-04	1.170393e-04	1.516796e-04
##	6099	3893	459	6820	2315	2957
##	6.711940e-05	1.999626e-05	1.407659e-04	9.677003e-04	1.056493e-05	5.022667e-05

##	5985	2845	4793	6154	2357	6402
##	1.543077e-04	1.103059e-04	1.946961e-03	7.654533e-07	8.145527e-06	2.024661e-04
##	4239	1559	315	2153	1118	1720
##	9.367041e-07	1.482074e-04	1.206423e-04	1.902270e-04	2.362452e-05	1.728084e-03
##	4222	4037	3898	6367	5113	441
##	1.644256e-04	1.871211e-05	1.500987e-04	5.099752e-06	1.291856e-03	9.381366e-04
##	559	1246	2275	3799	1621	1507
##	1.064119e-04	1.304089e-04	1.719384e-04	8.228383e-05	1.515163e-04	2.029382e-06
##	1282	3572	5508	767	4544	6368
##	5.418582e-06	2.640829e-05	3.049463e-05	8.380255e-05	3.752024e-06	1.322459e-06
##	2668	3521	5993	3063	281	7002
##	1.442130e-04	2.175102e-05	3.121113e-03	1.927239e-05	1.037521e-04	2.619169e-04
##	3916	3770	2894	5516	1053	2608
##	1.190318e-05	5.486733e-06	3.805666e-04	1.826869e-05	2.919098e-05	1.255871e-04
##	708	391	1955	5428	3205	6347
##	2.810007e-04	1.381259e-04	1.155665e-04	5.211344e-05	4.184373e-06	2.834658e-04
##	5580	2942	6995	4927	5966	6397
##	1.883552e-03	1.784042e-05	4.142314e-06	4.365843e-06	2.697778e-05	5.791744e-05
##	425	3858	5300	2094	501	3380
##	5.765534e-05	8.747262e-05	2.036312e-04	4.550181e-05	4.265867e-04	1.407901e-04
##	4569	178	5211	4523	167	109
##	7.620352e-05	1.311238e-04	3.197982e-03	8.750234e-06	1.282007e-04	4.789930e-05
##	2599	3339	4887	1967	5160	4597
##	2.096871e-04	1.372988e-04	6.671339e-05	3.129024e-05	1.843910e-04	1.927433e-04
##	5695	3561	2132	2313	2119	1838
##	1.965542e-05	7.962220e-05	1.165145e-05	1.863350e-05	7.162133e-05	1.457951e-03
##	703	2271	6455	3236	2811	1278
##	5.576764e-05	1.165443e-04	3.215987e-05	2.321983e-06	4.736252e-05	2.211337e-07
##	4772	2373	6838	3155	2120	6708
##	1.165375e-04	8.594976e-06	3.006504e-04	2.472087e-04	2.638763e-06	3.112773e-07
##	910	1820	2688	490	1414	1045
##	9.209457e-05	3.207936e-06	8.920277e-05	1.170414e-04	1.720801e-05	8.165899e-05
##	4368	6935	2997	1966	4066	2301
##	1.865302e-05	3.460522e-05	3.941232e-05	6.669164e-04	1.479343e-03	6.226739e-04
##	2087	7032	3896	6877	6583	1580
##	1.472100e-04	7.324594e-06	1.321267e-06	6.644595e-05	3.552830e-05	1.410359e-04
##	2715	1680	1355	14	3932	2104
##	3.069658e-05	8.495880e-05	1.488686e-04	6.120225e-04	3.776762e-05	1.035155e-04
##	877	572	1999	2587	4553	3768
##	1.398251e-04	1.279967e-05	3.682015e-04	3.022932e-06	4.752808e-05	1.018926e-04
##	1037	1658	5531	5303	5052	4177
##	1.525246e-04	7.635067e-06	1.372166e-05	9.340680e-05	7.049466e-05	1.848608e-05
##	937	871	1918	5591	1253	1237
##	5.433437e-04	1.657195e-05	7.540070e-06	1.116500e-05	1.647326e-04	1.189883e-04
##	6970	1922	2919	4351	67	5537
##	1.426278e-03	7.055456e-06	7.367828e-05	1.726387e-05	2.080481e-05	5.986072e-04
##	3222	1311	4025	3690	2806	6582
##	1.341668e-04	2.590861e-04	7.077721e-05	1.225022e-04	5.305201e-06	1.144988e-05
##	1449	5515	1072	5987	5719	437
##	1.348986e-05	1.889686e-04	2.809538e-04	1.886238e-04	1.264330e-04	5.862112e-06
##	3924	5856	119	6448	1886	3618
##	1.101690e-04	5.069629e-06	3.977980e-06	9.529627e-06	4.105749e-05	4.644231e-04
##	3845	6728	3090	5973	1540	513
##	2.565954e-04	4.401667e-05	6.685498e-06	2.708327e-04	1.293931e-04	1.281344e-04

##	6029	5481	2724	5301	154	2049
##	1.577198e-04	1.875789e-04	1.526976e-05	1.108348e-04	1.182163e-05	1.681871e-04
##	5621	1643	2331	502	1815	4039
##	3.376344e-05	8.905313e-06	3.213303e-05	5.053194e-06	3.333765e-05	7.601196e-07
##	107	5074	6343	852	4463	5982
##	2.776550e-05	3.114632e-05	1.305255e-04	1.895965e-05	1.501008e-04	4.904188e-06
##	4968	21	1659	1442	306	3086
##	1.464881e-04	4.985944e-04	7.352408e-04	2.942882e-05	1.990613e-06	9.296784e-05
##	4256	6218	4210	6661	3757	3539
##	1.395984e-04	9.598843e-06	1.182025e-05	1.270667e-04	1.169283e-03	2.498958e-05
##	1584	4854	2274	4828	7031	808
##	9.458795e-05	3.233411e-05	8.378118e-06	1.462378e-04	1.410498e-04	5.448519e-05
##	1481	4457	3352	6654	6505	3809
##	9.188762e-06	4.464764e-07	2.908807e-04	1.400396e-05	1.150370e-04	1.185460e-04
##	4648	5781	4340	3154	917	607
##	1.193383e-04	1.409851e-06	2.312921e-05	3.117533e-05	6.227745e-05	3.115723e-05
##	1784	964	3595	5442	1213	2475
##	1.215140e-04	1.068128e-05	6.230347e-05	4.521172e-03	1.535002e-04	1.027902e-04
##	5326	5220	6881	3484	3901	5209
##	8.796236e-05	1.670211e-04	3.030905e-07	9.303966e-05	5.859186e-06	5.385003e-05
##	1788	1640	5808	3929	1149	4452
##	1.576131e-04	4.757713e-04	8.992346e-07	2.984533e-04	1.017575e-04	4.233858e-05
##	2961	72	3088	230	2470	3171
##	1.901360e-04	1.551330e-06	1.218589e-04	2.365647e-05	8.887335e-06	1.866188e-04
##	3421	562	2551	507	4307	5143
##	3.856697e-05	1.284343e-04	1.065817e-06	1.705126e-04	2.315062e-04	4.201276e-05
##	4758	1562	1312	4646	4666	2211
##	1.660146e-04	1.162156e-04	9.656549e-06	2.477419e-04	9.253636e-07	3.332664e-05
##	6223	2951	1504	3715	2555	5605
##	1.164341e-05	9.985377e-05	9.984858e-05	2.502971e-06	3.470448e-05	6.455378e-05
##	3605	531	1416	3582	4420	4852
##	4.776615e-06	1.282373e-05	4.022415e-05	6.874396e-06	5.542213e-05	1.273803e-04
##	3212	1638	4030	410	5741	4162
##	2.018260e-05	6.988077e-07	3.734673e-06	1.490123e-03	8.929230e-07	1.674642e-04
##	4152	3811	1199	6665	568	3941
##	5.390814e-06	1.873322e-04	3.711936e-06	1.754668e-04	3.556349e-06	1.998831e-05
##	1274	2941	2176	1721	4865	6584
##	2.668984e-05	4.250386e-03	2.235247e-04	5.420985e-04	9.593321e-05	1.364709e-05
##	3161	2923	3126	5730	252	1626
##	1.328704e-06	1.932670e-04	1.012891e-04	1.822670e-05	1.255533e-04	1.351898e-04
##	324	3092	5767	5287	4047	3082
##	6.633500e-05	1.028338e-04	3.597288e-05	1.293526e-04	1.152235e-05	1.215409e-04
##	2833	1581	3802	2794	3827	2220
##	2.102943e-05	5.247732e-05	1.623955e-04	3.693929e-04	2.050009e-04	1.924678e-04
##	5499	5550	5280	765	1965	3325
##	3.420408e-04	1.013254e-04	3.684989e-07	4.429929e-07	2.662704e-06	3.802772e-04
##	1511	6224	3374	6766	6596	4902
##	4.935899e-06	1.334845e-04	1.175391e-04	4.204678e-07	5.506216e-06	1.165533e-04
##	4684	6827	3476	6354	3778	1828
##	1.550792e-04	1.035841e-04	1.401725e-04	6.642670e-05	2.282398e-06	1.039797e-05
##	2403	1936	1080	6875	1292	775
##	7.418817e-05	1.658295e-06	2.339501e-04	2.185896e-05	1.274868e-04	2.551381e-04
##	115	3342	975	6024	3783	2488
##	3.054525e-06	6.265594e-06	9.100703e-06	1.640417e-06	2.377471e-04	3.410282e-05

##	3959	1060	3430	4042	3336	6339
##	1.355981e-04	2.078603e-04	1.365707e-06	1.268586e-05	3.697568e-05	1.663370e-04
##	690	4447	1515	2529	6754	1179
##	1.975573e-05	1.151354e-04	5.273179e-07	1.254413e-04	9.291035e-06	1.409713e-04
##	3678	3616	1156	1908	2006	6372
##	1.813898e-04	1.943005e-04	4.477126e-06	2.544951e-04	6.023826e-04	1.495579e-05
##	6004	6302	4800	2564	6334	6750
##	1.070310e-05	2.329035e-06	4.225521e-05	1.847412e-04	1.455520e-03	5.097612e-06
##	3669	5914	1765	1753	1320	839
##	3.273076e-05	8.267298e-05	7.378400e-06	2.225321e-05	1.500958e-03	3.238878e-05
##	393	3009	3295	5977	3940	6906
##	1.626659e-04	3.719366e-05	1.271945e-04	1.506573e-05	1.120864e-04	2.011170e-05
##	244	4745	1583	4876	6163	2893
##	1.758005e-05	4.955785e-07	8.795799e-06	6.672324e-04	3.377926e-06	1.667293e-04
##	6904	2712	5759	4840	344	729
##	2.654917e-05	1.841217e-04	1.400079e-05	1.271096e-04	5.574834e-07	2.079540e-04
##	739	4499	5913	4396	6489	368
##	2.502360e-05	3.683594e-05	6.388201e-04	2.612161e-03	1.261915e-04	1.641166e-04
##	4834	813	190	5891	1021	5271
##	3.799389e-06	4.503318e-06	1.548140e-05	7.316709e-06	1.450551e-05	2.054115e-03
##	2089	53	1042	2853	3711	3461
##	2.153489e-05	3.872256e-05	2.177766e-05	9.110578e-06	4.410142e-05	6.466955e-05
##	4139	3298	5334	846	1306	6990
##	1.066905e-04	2.878866e-05	1.336919e-04	2.438214e-05	3.023579e-05	6.289143e-05
##	1819	6301	6641	2394	5124	374
##	8.341967e-06	4.888396e-07	2.573097e-05	2.473665e-04	1.440894e-04	4.555758e-05
##	314	3085	4249	3567	960	566
##	1.877635e-04	4.798229e-05	2.117573e-05	1.796443e-05	5.343126e-05	3.361351e-06
##	6805	1300	1461	4912	5470	863
##	6.241879e-04	3.718220e-04	1.202596e-04	5.825454e-06	3.838700e-05	1.808306e-04
##	5038	4164	6573	6399	1134	5903
##	1.145466e-04	4.618239e-06	1.187708e-05	2.900832e-03	1.413767e-04	6.909459e-05
##	5680	6375	3437	3322	3853	3982
##	1.343199e-04	2.295232e-07	1.120126e-05	6.752860e-07	1.651390e-04	3.530072e-04
##	5354	5646	838	4618	145	5573
##	3.372811e-05	4.458108e-06	3.759064e-04	1.420843e-04	3.098710e-07	4.096418e-06
##	1789	3400	1712	1185	4115	6005
##	9.412904e-07	2.309468e-05	3.190857e-07	1.865597e-04	1.659992e-06	8.087951e-06
##	3790	1099	3788	7007	5348	2402
##	4.841775e-05	1.094016e-05	3.548641e-05	3.445345e-04	1.911314e-04	5.940511e-05
##	5063	4022	1435	5257	5715	4546
##	1.701917e-03	1.426278e-03	1.440035e-04	6.899211e-04	1.078241e-04	1.872293e-04
##	601	4777	5999	1681	2908	2413
##	8.825921e-05	1.844247e-04	2.140515e-06	1.340323e-06	1.558662e-04	4.999716e-03
##	6273	340	6150	66	3748	1557
##	8.239049e-06	1.620298e-03	1.758707e-04	3.110649e-04	1.420122e-04	1.017607e-04
##	3923	5560	787	3645	6884	969
##	1.428295e-05	3.675543e-05	1.562729e-06	5.588378e-06	2.000812e-04	4.266928e-06
##	3279	5273	2464	6682	732	1466
##	7.331954e-06	1.233127e-04	3.709780e-04	1.082797e-04	8.715337e-05	3.628784e-04
##	4421	1328	5703	3141	3594	1785
##	3.371724e-05	1.168498e-03	2.593362e-03	1.118714e-04	1.352592e-04	1.325343e-03
##	196	6834	5119	323	884	6873
##	2.687387e-04	5.035892e-04	2.983023e-05	1.874005e-04	1.072150e-04	8.591415e-06

##	5729	2517	1889	4280	6737	2447
##	1.477635e-04	1.464909e-04	3.025271e-05	1.449416e-05	3.828725e-07	1.757411e-04
##	1387	6702	5046	1383	4019	3187
##	1.082589e-05	1.833693e-04	3.345278e-05	3.273715e-06	1.528612e-04	8.944371e-07
##	6090	4719	2336	4619	1104	617
##	1.027027e-04	1.596407e-05	1.191275e-04	8.315832e-04	8.002511e-05	5.985079e-05
##	6330	3978	2485	723	4466	1289
##	1.153454e-04	7.885159e-05	3.368121e-05	1.131322e-04	2.236871e-05	4.792214e-07
##	4998	4755	933	4108	3553	5739
##	3.647543e-04	4.523213e-07	2.102598e-07	1.304735e-05	4.130246e-05	1.419307e-03
##	3498	5547	3965	5818	5154	5234
##	2.585823e-04	1.182816e-04	9.187995e-05	3.759064e-04	5.321529e-05	1.152532e-04
##	5026	2491	4905	6725	5512	2868
##	1.735143e-04	9.417034e-05	2.499967e-04	3.238774e-03	4.675440e-06	1.232380e-05
##	6384	2808	5581	3351	4762	371
##	2.460314e-05	6.402907e-05	2.140783e-06	3.815189e-04	2.996759e-07	7.036024e-06
##	2657	2061	4180	5577	2987	5674
##	2.098880e-05	8.703674e-06	1.195423e-04	2.243571e-04	9.572893e-06	1.066911e-04
##	891	4187	5884	6136	1360	2474
##	6.446395e-05	6.398569e-05	2.995693e-05	1.275665e-04	1.246121e-04	7.489456e-05
##	1606	2042	6856	4661	5330	3313
##	4.348092e-07	6.588520e-05	1.918414e-05	1.448395e-03	1.522445e-03	1.664354e-04
##	5266	864	4054	5490	4693	5391
##	1.149086e-05	1.041906e-04	6.843126e-05	4.249451e-05	5.039651e-04	1.349049e-04
##	5551	2435	2880	386	4753	1392
##	1.517503e-05	1.198097e-04	2.040113e-03	1.265543e-03	1.324091e-05	6.494292e-05
##	3305	6714	423	6726	54	2143
##	8.296744e-05	1.700830e-05	1.750738e-04	4.945088e-06	1.306990e-04	4.262973e-05
##	780	2254	5097	6337	5473	552
##	3.492628e-04	3.533122e-06	7.190013e-06	1.136380e-05	6.866966e-05	1.201276e-04
##	2913	1433	2105	282	497	4317
##	8.292986e-05	6.168661e-06	1.360973e-04	6.174164e-05	2.715842e-05	1.069667e-05
##	4685	4959	2996	6979	4561	52
##	2.266500e-03	2.480559e-05	1.749995e-04	5.404758e-06	4.619299e-04	1.551833e-04
##	4838	6526	1532	920	631	4288
##	1.254683e-04	1.186155e-06	7.757793e-06	4.122908e-04	4.581704e-04	1.900351e-03
##	557	1288	2009	2480	757	590
##	1.656420e-04	2.775593e-04	1.165954e-04	1.114607e-05	3.969618e-07	1.033323e-05
##	868	2860	799	1870	5461	1623
##	8.839436e-05	8.698831e-06	1.658417e-04	2.831833e-07	6.446469e-06	1.756130e-05
##	3557	2889	5146	4846	6221	4788
##	7.414635e-05	1.228097e-04	5.645520e-07	2.587833e-05	6.423122e-05	1.356740e-04
##	6396	5017	6288	5059	4250	4751
##	3.708947e-04	1.339099e-03	1.755391e-04	2.061333e-05	9.388796e-05	6.297326e-05
##	243	4760	6729	5282	850	3719
##	2.115862e-05	1.118075e-04	1.362021e-04	2.618487e-06	8.227812e-06	3.644598e-05
##	1790	4898	3341	5236	2458	5745
##	2.219028e-06	3.027696e-05	1.180617e-04	2.454723e-04	2.022319e-05	1.596706e-05
##	4262	6238	2661	3607	3422	4186
##	5.189390e-06	1.251159e-04	4.798603e-05	2.707157e-05	1.698168e-05	1.672145e-04
##	6561	5198	2503	6810	395	778
##	1.294991e-05	7.526057e-05	3.888036e-07	1.222147e-04	5.240140e-05	1.108415e-04
##	554	4533	1110	6411	621	2028
##	1.623110e-05	1.645560e-04	1.359650e-05	9.462205e-06	5.343297e-05	1.244186e-05

##	3697	4935	2453	4450	4179	4176
##	2.655094e-04	5.855113e-05	1.443929e-04	6.745849e-05	2.247412e-06	6.755321e-07
##	3159	7003	6958	3765	2018	3453
##	4.136322e-04	6.126993e-05	3.493044e-04	4.046599e-05	4.965775e-06	1.874430e-04
##	5799	2711	3984	6959	2566	6606
##	1.155844e-04	1.247125e-05	1.181404e-03	2.930508e-05	3.302649e-05	2.453828e-03
##	5927	4860	2689	4526	6516	4993
##	2.831008e-04	1.041720e-04	1.210104e-04	8.200685e-05	2.924276e-03	2.804820e-06
##	4157	5021	4337	3357	4482	6230
##	1.653409e-04	3.818484e-06	5.667981e-05	2.575220e-04	8.977601e-06	6.100514e-06
##	6872	1687	1266	6982	185	3226
##	3.595412e-05	4.354154e-04	2.776458e-05	1.137888e-04	1.303344e-04	9.740143e-05
##	5527	2264	783	1954	789	6787
##	2.056379e-06	1.168923e-04	2.677988e-05	1.156936e-04	6.269475e-05	2.926276e-04
##	3646	1180	201	4943	5840	2172
##	4.714420e-05	4.748058e-05	2.235853e-04	2.537776e-04	2.123992e-04	1.915772e-04
##	4895	2916	4207	4880	788	4145
##	8.754595e-06	2.230191e-06	1.635890e-04	1.573609e-05	2.644801e-05	3.944649e-04
##	1907	4065	2305	1357	5085	3256
##	8.670682e-06	1.902725e-04	2.953352e-05	1.767023e-04	1.432966e-05	8.725281e-05
##	4556	443	5157	514	6378	3957
##	1.731007e-05	1.926224e-04	4.025932e-05	8.154410e-05	3.703822e-04	1.139676e-04
##	259	4395	5116	3529	3053	1474
##	3.623165e-04	3.864063e-05	1.512842e-05	1.464538e-03	1.906622e-05	1.755470e-04
##	2735	6303	99	916	1222	5814
##	3.722899e-05	1.219633e-04	1.605776e-06	1.182295e-04	5.119421e-05	2.214102e-04
##	6353	3707	6780	4018	4563	240
##	5.135886e-05	6.446307e-05	2.192144e-05	2.904760e-05	1.199798e-04	2.175505e-05
##	3854	6335	4489	242	4616	4409
##	1.981001e-05	4.645883e-05	6.700963e-04	6.323283e-05	2.289423e-06	3.239136e-06
##	6371	2233	4093	253	1187	6828
##	4.783104e-04	5.351044e-06	1.663370e-04	4.825725e-04	6.340026e-06	1.004559e-05
##	3152	4532	2217	4540	4282	6497
##	9.507304e-05	1.387767e-04	1.028444e-04	2.374221e-03	3.827195e-06	3.466099e-04
##	6083	5161	4451	5833	5917	5072
##	1.197116e-03	3.584927e-04	2.022250e-04	1.724377e-04	1.038993e-04	3.765166e-04
##	1573	2576	3501	6929	5086	2408
##	3.487236e-04	5.903187e-06	2.767150e-05	1.051290e-05	1.130150e-05	1.250879e-04
##	3625	1405	4400	665	4129	4882
##	2.523493e-05	6.980201e-06	3.294311e-05	9.320616e-07	9.664257e-03	4.862288e-05
##	2775	6870	3560	6823	5946	6444
##	9.637777e-05	3.074564e-03	1.034978e-05	3.339493e-04	3.164557e-05	4.711756e-05
##	349	2206	4439	890	5513	3078
##	2.693914e-05	1.168314e-04	2.185254e-06	1.326919e-03	7.395372e-05	1.229851e-05
##	279	928	5783	1116	2209	277
##	4.678070e-05	1.611339e-04	1.258268e-04	1.535569e-05	9.216036e-05	9.154926e-04
##	4770	3511	1269	341	2098	5221
##	6.028422e-06	1.932014e-04	1.376320e-03	2.149416e-05	5.727911e-04	2.604844e-05
##	4479	2731	6461	3863	1406	1018
##	1.472801e-04	1.083102e-04	4.275714e-04	3.744750e-07	1.148902e-04	6.344206e-07
##	6711	5684	3804	1162	6473	7033
##	1.960702e-05	2.104088e-03	1.168732e-03	8.063606e-04	2.528003e-05	1.151929e-04
##	3782	1261	2065	3139	4550	255
##	8.706634e-06	1.646065e-04	8.173685e-06	3.564263e-04	2.670676e-04	4.216622e-05

##	6454	1550	5372	640	670	1121
##	5.841901e-04	3.450681e-04	9.014864e-04	1.342288e-04	2.085782e-06	4.729671e-05
##	3220	2543	3806	5193	5207	4856
##	1.455139e-05	3.012302e-05	1.215140e-04	7.240622e-07	2.712251e-05	4.680440e-05
##	1331	5095	2039	269	4598	812
##	3.108999e-05	1.240668e-05	1.855341e-04	1.781506e-02	1.181509e-04	2.200076e-03
##	5459	1178	4980	776	2728	4120
##	2.434232e-04	2.187056e-05	1.349431e-06	8.280641e-05	1.152842e-04	5.830495e-06
##	999	5647	6443	2463	3261	2223
##	2.295051e-07	1.515492e-03	1.911624e-06	2.997796e-04	2.872214e-04	1.155132e-04
##	7010	5239	1356	2755	5281	4217
##	1.656005e-04	2.027461e-05	4.822786e-05	1.368142e-04	4.138896e-05	9.668708e-06
##	5199	4729	3676	3988	1679	6567
##	7.354111e-04	6.095557e-06	1.668268e-04	1.366382e-04	4.895260e-05	1.633005e-04
##	2993	2036	3096	826	4339	4653
##	4.294457e-05	1.763863e-05	2.735517e-04	1.516383e-04	1.059782e-04	1.282603e-05
##	3974	6415	6535	1543	6610	4681
##	1.544986e-05	5.313430e-06	4.083917e-05	2.733750e-06	1.454407e-03	4.434471e-05
##	183	3065	4088	2605	7018	1856
##	1.307216e-04	4.295538e-05	4.448842e-05	1.734194e-04	1.735731e-06	2.572104e-06
##	5510	2798	785	4784	3868	680
##	3.210167e-04	9.724201e-05	1.675831e-06	3.034468e-06	4.310088e-05	2.183210e-05
##	6121	4983	6057	4739	1833	1522
##	1.149584e-04	1.424038e-03	7.890260e-06	1.010737e-04	7.233892e-03	2.625924e-05
##	231	897	1022	1184	3546	7023
##	1.039044e-04	1.610151e-04	2.975581e-05	2.846635e-05	3.848925e-05	3.675372e-05
##	394	5088	1107	5000	2999	1198
##	1.717973e-05	1.419268e-04	2.881642e-05	2.176773e-05	3.328528e-04	2.410124e-05
##	781	6735	5387	1489	4539	2127
##	3.709524e-06	2.759059e-04	5.778205e-05	1.914007e-04	1.119597e-04	1.873058e-04
##	555	6363	4498	6679	2870	3577
##	2.745003e-04	3.356296e-04	3.115027e-05	1.756953e-05	1.318882e-04	2.698830e-07
##	2367	5538	3017	6646	1351	1794
##	1.246551e-04	1.111915e-04	2.063964e-04	1.412158e-04	3.782627e-06	2.947591e-07
##	4237	4921	935	1998	6200	2645
##	1.657420e-04	2.450396e-07	4.267359e-05	3.583753e-05	4.172210e-04	9.120128e-04
##	2805	6254	4862	6138	5633	6598
##	1.058781e-03	3.682918e-06	1.172252e-05	2.119758e-04	8.970517e-07	1.359163e-04
##	4877	4940	6016	6141	6609	4914
##	1.181578e-04	1.635975e-04	2.992525e-04	1.198042e-04	4.433531e-04	1.142849e-04
##	4491	4679	5456	3470	6312	4365
##	3.208399e-04	1.027903e-04	7.559587e-05	2.854542e-04	4.413599e-05	8.603321e-06
##	4199	4600	5604	3888	1101	5791
##	1.777696e-06	6.699632e-06	2.941494e-04	1.377056e-04	2.684441e-05	1.437897e-05
##	6597	4231	6705	4116	1762	2990
##	8.300283e-06	1.394220e-04	7.685405e-05	1.357970e-05	1.112081e-06	1.642198e-04
##	6994	1851	2243	2940	1663	923
##	6.913712e-04	1.433739e-05	3.925579e-06	1.361758e-04	1.321836e-04	9.229634e-05
##	7004	6270	6730	3578	6130	6798
##	1.737238e-05	1.048324e-05	4.519136e-06	6.687142e-04	4.200248e-06	4.074854e-05
##	1349	170	2439	343	5652	3014
##	1.275592e-04	2.219940e-05	1.136679e-04	4.179447e-06	4.432444e-04	3.425830e-05
##	2465	1752	6394	586	1451	1055
##	1.135898e-04	1.599205e-04	1.233376e-04	1.065067e-04	5.508898e-05	3.496769e-04

##	3223	1698	5153	3824	3825	2499
##	1.675728e-04	7.221365e-06	1.585012e-06	4.238598e-06	1.370140e-04	2.929197e-05
##	346	4694	4822	3108	1903	2950
##	3.224733e-04	2.051107e-06	5.665638e-06	1.065255e-04	8.339812e-06	7.241381e-06
##	1593	366	2352	4857	6459	1957
##	5.505084e-04	1.114867e-04	1.356074e-05	2.004988e-04	9.677316e-05	2.360112e-05
##	5291	2646	4388	5286	844	5574
##	2.143943e-06	1.654415e-04	1.663370e-04	5.032514e-06	3.645628e-05	1.253502e-04
##	2750	1218	6420	2753	6768	6010
##	2.892314e-05	7.447555e-07	7.125509e-06	2.362601e-03	5.455967e-06	8.141911e-04
##	2005	1655	403	5039	3880	5248
##	1.752015e-04	1.633883e-04	2.081767e-03	4.163594e-05	3.471029e-04	1.783477e-04
##	5465	4688	4376	6653	5496	5268
##	1.191832e-05	2.068503e-04	1.235440e-04	5.190804e-06	1.266875e-04	4.859401e-05
##	376	858	2192	2483	5302	4173
##	2.879747e-05	2.599249e-04	1.021080e-04	1.627265e-04	1.861868e-04	1.648345e-04
##	4295	938	3179	4951	3340	2111
##	2.558264e-04	1.289336e-04	9.001391e-04	1.131156e-04	9.722624e-06	1.212330e-04
##	5529	519	6237	1173	6621	143
##	1.524271e-05	3.093339e-04	1.320801e-04	1.397650e-04	1.102098e-04	3.435293e-05
##	5558	360	4045	1132	1085	5919
##	3.436036e-04	6.072003e-05	6.632927e-06	1.602131e-04	1.494282e-06	7.761413e-07
##	4818	4433	2571	4195	5836	3944
##	1.656420e-04	1.292751e-05	2.031796e-04	3.509086e-07	8.084535e-06	1.871925e-04
##	6032	1571	151	5829	2702	3464
##	3.954235e-05	1.322279e-05	1.311170e-04	2.896702e-07	6.264911e-07	5.198704e-05
##	4448	805	2869	3043	2532	1189
##	6.276618e-05	1.256103e-04	8.380904e-05	7.188802e-03	3.205107e-07	1.085147e-04
##	2769	2684	5353	2266	4767	965
##	3.338684e-05	1.227339e-04	1.892538e-04	1.120762e-04	1.003749e-04	3.481254e-04
##	5190	3190	3409	1883	5371	2079
##	1.960815e-04	2.386694e-05	2.432530e-04	2.585857e-05	2.552121e-04	4.322736e-05
##	3832	1062	3138	3424	6662	5446
##	1.928136e-04	8.698419e-05	1.869402e-04	2.628140e-04	1.469340e-06	1.374646e-05
##	2177	301	198	6441	1409	5451
##	3.522186e-07	3.712394e-05	1.298278e-04	1.564184e-04	3.631052e-05	1.072774e-04
##	5213	2262	6797	6054	6495	2787
##	6.590768e-07	8.407941e-06	1.908568e-04	4.213722e-06	1.518889e-05	2.689865e-05
##	105	1629	5698	3949	5177	4718
##	2.700139e-03	7.914790e-05	2.685641e-03	1.885709e-05	2.479494e-05	3.116574e-04
##	692	5640	715	6835	5365	4708
##	3.560391e-05	7.468015e-05	3.075410e-07	3.480075e-05	1.636149e-04	1.396259e-04
##	1492	1353	3762	1682	3447	6469
##	1.649362e-04	1.939573e-06	5.162888e-06	2.987523e-07	1.065384e-04	4.032108e-05
##	4908	2077	5383	3860	189	3147
##	3.087031e-07	5.344559e-05	5.135142e-06	3.110133e-05	2.923006e-05	1.127658e-04
##	5295	2494	6521	4083	381	4387
##	8.225748e-05	5.961771e-04	1.102351e-04	7.770652e-04	3.890615e-05	4.387384e-03
##	6882	6595	1395	2714	5394	1404
##	1.388644e-05	2.682913e-05	1.124617e-04	1.667293e-04	1.236560e-04	1.175930e-04
##	6991	375	2389	2048	6578	239
##	6.469554e-05	7.613935e-05	1.985830e-04	3.509211e-04	3.725507e-06	1.271284e-04
##	6097	3999	44	5049	1671	5699
##	2.965989e-04	1.423548e-05	8.784415e-06	4.949822e-05	2.694729e-04	1.698238e-04

##	4151	1743	4632	2617	2558	4586
##	4.927133e-04	1.081527e-04	1.170631e-04	3.450581e-04	1.426530e-04	1.069840e-04
##	5013	3151	1904	6613	6968	6639
##	3.291246e-05	2.335044e-05	7.905401e-04	1.252327e-04	1.905613e-04	1.013091e-06
##	1927	5464	4007	6207	5081	6759
##	5.847411e-04	3.770218e-04	2.169676e-07	3.975540e-05	1.547650e-05	1.015759e-05
##	5331	2100	4634	3246	650	4768
##	1.323775e-04	2.801851e-05	2.824600e-07	1.826508e-04	3.872754e-05	1.655419e-04
##	5661	4404	1077	5978	4481	3661
##	2.109583e-05	2.571226e-05	1.117892e-06	1.006032e-06	1.264380e-04	7.767438e-05
##	748	5815	4964	5133	6247	4040
##	3.082574e-04	2.233226e-05	1.671128e-05	2.746595e-06	9.455531e-06	6.435820e-04
##	2050	4089	1487	3132	4535	2436
##	7.322954e-06	1.290019e-04	2.050750e-04	4.186737e-06	1.893389e-04	5.280392e-05
##	5029	4781	1227	5831	1030	2660
##	4.924161e-05	1.272989e-04	2.924126e-07	1.056573e-05	1.109070e-04	1.270582e-05
##	420	5188	1836	5218	5437	2572
##	1.157577e-04	1.113248e-04	1.874575e-04	4.696587e-05	1.964839e-04	8.890960e-05
##	5578	5864	944	1526	3713	548
##	1.580432e-06	1.592937e-04	2.325549e-06	6.624040e-05	1.869088e-05	4.838868e-05
##	6217	6009	1314	430	6969	2874
##	8.378657e-06	2.356286e-05	6.115958e-04	2.502248e-06	1.749974e-04	1.829546e-04
##	6114	3589	2841	5857	6570	5569
##	6.202667e-05	1.207657e-04	8.904552e-05	5.181251e-05	5.566236e-05	4.764635e-05
##	950	3300	4675	3763	611	4229
##	6.042079e-06	2.073771e-04	2.694023e-05	3.967542e-05	7.681817e-04	1.287864e-04
##	4714	4391	1268	1201	4049	5478
##	6.452664e-05	3.426572e-05	6.869196e-06	1.411663e-04	5.488222e-06	5.605830e-06
##	4122	5364	2449	6942	6365	4155
##	2.035345e-04	3.743197e-07	1.304375e-04	3.233396e-06	1.214831e-05	1.251955e-04
##	6727	5672	2362	1115	5246	6296
##	1.246862e-04	8.909971e-07	3.430466e-04	1.233387e-04	2.721010e-07	2.164001e-06
##	1441	2410	1068	4184	5149	1878
##	5.548115e-05	2.958543e-05	1.080927e-04	1.837686e-04	2.580129e-05	7.353628e-06
##	4868	6194	5070	4071	2553	774
##	1.347554e-04	7.576227e-04	1.203005e-04	1.142009e-05	3.348993e-06	1.173610e-04
##	3755	5104	537	2969	5750	4577
##	1.659412e-04	5.614771e-05	9.151183e-06	7.223947e-04	3.898670e-05	2.182771e-05
##	7005	1013	4608	6472	5084	6894
##	6.619593e-05	6.379966e-04	2.118956e-04	1.862211e-05	2.357107e-05	1.959124e-04
##	4918	3338	6014	6859	6351	3289
##	2.390036e-05	2.102306e-04	7.344543e-05	1.612369e-04	1.224150e-04	3.019223e-05
##	6361	867	6308	4414	1183	1352
##	1.440293e-03	1.724786e-06	7.423047e-06	1.573663e-04	4.790644e-06	3.838370e-05
##	5975	3805	5807	3796	689	204
##	4.308383e-05	2.107131e-04	1.446208e-03	2.040871e-04	2.548487e-06	1.416571e-04
##	3140	5452	655	1082	5176	6250
##	8.689434e-04	1.493524e-05	1.286695e-03	6.177332e-05	1.621927e-05	2.987607e-04
##	1909	6537	1709	6694	6464	2066
##	2.973562e-07	1.737018e-04	1.231588e-04	2.404967e-05	7.450174e-06	4.481718e-05
##	4869	6276	6119	3150	5023	6491
##	2.905022e-04	6.327053e-06	1.907467e-04	1.070830e-04	6.775471e-05	1.049745e-05
##	4817	4055	2812	3414	4417	2088
##	1.110154e-05	2.580961e-05	4.442325e-06	6.606694e-05	7.994190e-05	6.673876e-04

##	2080	418	3720	2525	6320	3216
##	5.448616e-05	5.143926e-06	8.822676e-06	2.181699e-07	1.658610e-06	2.414667e-05
##	5839	4942	4759	4017	4889	1332
##	1.188473e-05	1.397480e-03	1.047303e-06	1.875632e-04	1.118247e-04	1.748507e-04
##	5092	3861	5389	3378	3080	200
##	7.807532e-04	1.986194e-05	1.468619e-03	4.489853e-07	1.323619e-04	1.673109e-04
##	4	889	1894	4554	6563	1050
##	7.958777e-06	5.580561e-05	6.591972e-05	1.518486e-04	1.465654e-04	1.486524e-03
##	2342	2843	4606	1164	2167	6188
##	1.525929e-04	1.265399e-04	5.312196e-06	1.439166e-04	2.251685e-05	5.621608e-05
##	3438	1410	1618	2847	3285	4114
##	1.530649e-05	4.297144e-05	3.000741e-05	1.982112e-04	3.339587e-05	5.741997e-06
##	722	3542	1915	3674	5624	4213
##	6.775641e-07	5.237348e-06	1.902150e-04	3.880742e-04	1.402599e-05	1.027027e-04
##	4503	2789	1533	4531	3628	4303
##	8.268187e-04	6.430698e-06	2.661365e-05	3.571975e-07	2.197330e-05	2.219411e-05
##	1193	5669	2655	1432	5445	6765
##	1.291868e-04	1.015988e-04	1.025766e-04	1.606797e-05	1.529093e-04	1.269395e-04
##	429	146	1793	6493	3060	6165
##	7.478496e-05	2.703575e-05	1.800774e-05	1.212353e-05	6.227071e-07	1.850174e-05
##	1615	1205	3243	1529	5299	6279
##	1.918189e-06	2.161085e-05	8.860808e-05	3.575183e-05	7.669226e-05	3.397806e-05
##	1374	6110	3985	5899	1464	1875
##	1.655419e-04	1.704664e-04	3.005574e-07	8.198365e-06	1.285882e-04	3.358937e-05
##	6815	2195	1338	4519	2866	2300
##	2.689807e-05	1.113119e-04	8.066499e-06	1.376239e-04	7.124691e-05	1.046543e-05
##	4428	3075	5485	6685	2882	4353
##	6.305914e-05	2.165721e-05	2.316355e-05	4.814895e-05	3.193997e-05	1.578606e-05
##	6568	6206	2839	5691	2023	6869
##	4.757658e-04	3.712414e-04	3.852921e-06	2.051066e-06	1.918993e-04	1.506854e-04
##	1217	6281	3584	4736	5830	1969
##	1.303198e-06	2.899665e-05	1.805591e-05	2.855061e-05	2.724731e-05	4.792385e-05
##	2799	6591	2137	6919	4574	6833
##	1.216774e-04	1.231226e-04	2.710507e-04	2.475409e-04	2.274387e-07	1.455440e-06
##	3169	2568	5370	4390	1112	5460
##	1.739759e-06	1.121673e-03	6.568914e-06	1.603854e-04	1.097670e-04	3.685586e-04
##	3112	4797	3335	3241	2158	83
##	2.326258e-03	3.100966e-05	4.149702e-04	9.485599e-04	1.175962e-04	1.313051e-04
##	5902	5637	6440	1806	5100	3849
##	6.713593e-04	3.662007e-04	2.028313e-04	2.298810e-06	1.258802e-03	1.663922e-04
##	6414	195	525	698	2109	336
##	2.191843e-04	7.633911e-07	2.505023e-04	2.666559e-04	7.636897e-06	2.634230e-03
##	770	1377	6512	2788	3239	3931
##	4.688471e-05	1.306719e-04	2.706410e-06	3.201638e-07	1.073443e-05	7.614027e-05
##	4132	4832	2514	3942	2068	3211
##	1.443813e-03	2.971831e-05	1.448429e-06	6.704992e-05	4.730968e-05	4.939146e-06
##	2107	1130	1424	5716	6462	6800
##	7.651866e-06	2.778960e-05	1.466553e-04	2.428171e-04	2.167793e-05	8.239039e-05
##	2716	5019	3248	462	1864	5422
##	4.989701e-06	2.156266e-07	8.105375e-05	4.492418e-05	8.255485e-05	4.868154e-06
##	3629	2371	794	4715	5871	2382
##	1.236578e-04	1.121484e-04	2.647059e-05	1.336062e-05	9.937373e-04	3.729676e-05
##	539	2666	5062	1345	2253	6293
##	1.790064e-05	7.811490e-05	1.232315e-05	9.768027e-06	4.842128e-07	8.848948e-05

##	1585	2510	329	6189	6713	6709
##	2.592727e-06	3.035672e-07	1.710594e-05	1.861226e-05	7.318753e-05	1.360710e-04
##	4571	3114	446	2248	1711	5127
##	6.330770e-05	7.422758e-05	1.404811e-03	4.031877e-06	3.963982e-04	6.361759e-05
##	3408	1605	615	1090	2640	802
##	3.671567e-07	1.505629e-05	1.408803e-05	9.419780e-05	4.979581e-04	1.215122e-04
##	4051	2962	6271	303	2846	2473
##	3.932277e-05	5.347553e-05	9.115295e-06	6.711688e-04	4.933270e-04	4.612870e-06
##	644	2493	397	345	2151	3721
##	2.806268e-05	2.329330e-04	2.960199e-04	3.852611e-06	1.058327e-04	1.279250e-05
##	6681	1577	4596	5766	6265	3316
##	5.418216e-04	2.908072e-06	7.916008e-06	1.747012e-03	7.232061e-05	6.373666e-05
##	6290	6691	6908	1518	4700	666
##	2.716902e-03	6.437514e-05	9.266037e-04	4.332008e-05	1.090745e-04	3.023344e-04
##	6046	6294	1892	431	1394	3815
##	4.711105e-06	1.478107e-05	3.606584e-04	1.884520e-02	1.665336e-04	7.304003e-06
##	3549	1152	1339	3502	2855	1233
##	1.455224e-05	1.634930e-04	1.450869e-03	9.456796e-06	6.297932e-05	4.226606e-04
##	445	2029	3193	1243	4641	5837
##	3.209689e-05	2.410830e-05	8.423576e-07	1.909518e-05	1.249997e-04	7.476908e-05
##	5873	5068	6569	3375	3892	2740
##	1.258268e-04	3.424047e-05	5.420121e-05	2.073367e-04	1.470241e-05	5.286901e-05
##	980	6648	5179	2306	1369	2698
##	2.088330e-05	4.297857e-06	1.208484e-04	1.021997e-04	1.716437e-05	7.847160e-06
##	2867	4422	1732	5235	5675	6950
##	2.389596e-04	5.427158e-05	1.259477e-04	1.452717e-04	2.406260e-06	1.390044e-05
##	5780	4585	2205	5183	1327	1251
##	3.133054e-04	4.486334e-06	2.449978e-03	3.627304e-05	1.263650e-05	6.088068e-05
##	1412	5169	47	5950	820	1987
##	1.855542e-04	1.334741e-04	1.649624e-04	1.337365e-06	7.891356e-06	1.258261e-05
##	6389	3657	3018	5040	6792	817
##	1.433273e-03	7.980377e-06	4.404776e-05	1.117799e-04	7.433770e-04	1.090771e-04
##	1	4969	2965	6586	1708	6720
##	1.807139e-04	1.961767e-06	3.478140e-05	3.315127e-06	2.892914e-04	3.130509e-07
##	5114	458	6542	4416	1980	4467
##	1.245369e-04	4.904197e-05	1.745656e-05	3.960769e-06	2.796595e-06	1.190250e-04
##	1925	470	3427	439	1873	6156
##	9.600535e-05	2.164632e-04	1.254683e-04	5.318788e-05	3.790841e-06	1.391109e-03
##	6022	4313	5159	1221	6931	622
##	2.976145e-05	4.701570e-05	2.946963e-07	5.244372e-05	1.210088e-04	1.755213e-05
##	7008	5619	5641	6888	5317	438
##	2.136130e-06	3.744903e-05	1.112238e-04	7.319124e-06	3.461287e-05	1.486129e-04
##	1141	5361	2565	6546	6840	4804
##	2.910437e-04	1.174033e-04	1.672417e-04	1.293495e-04	1.282121e-04	5.106860e-05
##	1928	2881	5244	4013	152	2927
##	6.332234e-04	1.681914e-04	1.504117e-04	2.635430e-04	1.224799e-04	1.966218e-04
##	1354	4516	3987	1541	1215	260
##	4.117360e-07	1.852698e-04	2.136607e-05	8.903012e-06	1.831661e-04	2.217740e-05
##	2384	4701	1863	4543	2166	4321
##	1.789306e-05	1.662716e-04	6.641423e-06	3.736820e-05	2.987764e-05	2.563589e-07
##	6592	624	1881	3035	187	5670
##	1.270648e-04	1.582324e-05	1.103256e-04	1.073875e-04	3.319420e-05	7.883540e-05
##	5174	2170	4245	1668	2717	906
##	1.214688e-04	9.348487e-06	2.561187e-06	2.946261e-05	3.077414e-05	1.218227e-04

##	3166	4146	5375	424	311	5520
##	1.257006e-05	7.976200e-05	1.290567e-04	4.023599e-06	1.643228e-04	1.991895e-04
##	3443	77	3199	4786	3792	4913
##	1.530196e-04	1.078587e-05	1.413113e-04	1.557022e-04	1.670608e-04	2.946200e-04
##	878	4976	3933	1602	3485	6753
##	9.716109e-06	2.846627e-05	1.154617e-04	4.253935e-05	3.471594e-05	5.039923e-05
##	6199	3867	4859	1923	5413	2245
##	1.403152e-05	2.020048e-05	5.987244e-06	3.777917e-05	1.205789e-05	8.821903e-04
##	973	2815	2710	2221	6707	2276
##	8.382332e-06	2.724896e-06	1.491249e-05	4.362602e-06	1.656420e-04	1.168299e-04
##	3823	6087	1483	5253	4221	2495
##	7.247740e-04	6.828976e-06	4.891211e-04	5.826116e-05	1.136041e-06	4.432384e-04
##	2323	630	34	3302	404	943
##	2.026049e-06	5.952112e-04	1.662384e-04	1.259477e-04	2.238038e-06	5.707158e-05
##	1029	5369	5908	4438	2182	4953
##	2.321589e-04	1.267870e-04	1.872670e-04	4.324840e-05	2.062878e-05	1.282257e-03
##	4559	5129	5251	6135	6159	6324
##	2.016982e-04	6.692927e-05	4.458479e-04	9.456916e-05	1.391169e-04	1.636819e-04
##	2390	1984	2791	4909	122	1175
##	6.805265e-06	5.279648e-05	8.204813e-04	2.060146e-04	7.498390e-05	4.594508e-05
##	116	1033	6897	4716	7042	3002
##	7.072772e-04	1.277789e-04	3.860730e-04	1.058508e-05	1.227533e-04	4.883496e-05
##	4041	3909	4031	3382	1943	4134
##	1.811963e-06	2.143921e-04	1.160554e-04	2.562774e-05	2.449929e-06	4.221391e-05
##	2540	1801	3291	6047	162	1551
##	6.355103e-07	1.871565e-04	1.175118e-04	3.254267e-04	1.771447e-04	3.274870e-04
##	2875	5259	4367	211	43	3524
##	4.765782e-07	2.171382e-03	6.826294e-05	3.342664e-04	2.069610e-05	7.848295e-05
##	2598	2670	508	6983	5055	337
##	7.436626e-05	1.639683e-04	1.052376e-04	3.637518e-06	2.138385e-06	5.389431e-04
##	4392	5003	3040	800	2425	313
##	8.178965e-05	1.180428e-06	2.348098e-06	1.348778e-03	1.391506e-03	2.925636e-04
##	1448	3934	5667	2795	4829	1368
##	1.181813e-04	4.841260e-05	1.863875e-05	2.916655e-05	1.101026e-05	1.063198e-05
##	4316	1012	2578	2008	1548	6104
##	1.112678e-04	1.995878e-06	9.906435e-05	1.122157e-04	1.847441e-03	2.177832e-05
##	6736	6992	4286	3758	1604	5309
##	7.486592e-06	1.230819e-04	1.873395e-05	1.997340e-05	1.681974e-04	6.379437e-06
##	6457	4336	6429	1066	6721	4343
##	1.366375e-05	1.542295e-04	1.329189e-04	1.583059e-04	6.424812e-06	9.093032e-06
##	837	2097	1305	2024	117	6170
##	6.417775e-06	1.511849e-03	1.387134e-04	1.249294e-04	8.947271e-06	3.649454e-04
##	6812	6316	6098	771	5556	4791
##	2.664861e-04	1.698449e-05	4.789476e-06	3.803687e-05	2.663163e-07	5.144891e-05
##	4216	5632	895	450	1633	48
##	5.820431e-05	1.280189e-04	9.157551e-06	4.043466e-05	6.158457e-04	1.146582e-04
##	5090	6072	3490	1400	3274	6628
##	8.343786e-05	3.759595e-05	1.037510e-04	2.653005e-05	6.435759e-04	8.093826e-07
##	3041	3113	5625	873	5866	3903
##	2.686577e-03	2.436229e-05	1.490991e-05	4.030172e-07	1.228806e-04	1.807638e-04
##	4485	6360	4567	5702	5851	4311
##	2.984994e-04	1.419957e-05	2.537057e-05	1.052600e-04	2.004393e-04	2.574455e-06
##	4101	6741	3512	3459	5335	3816
##	1.794775e-06	4.723398e-04	1.791988e-06	1.945837e-04	6.946820e-04	1.221647e-04

```
##          5440          5318          4835          3664
## 2.327754e-04 2.577192e-04 4.828977e-07 4.000975e-04

sum(residuals(mod3,'deviance')^2)

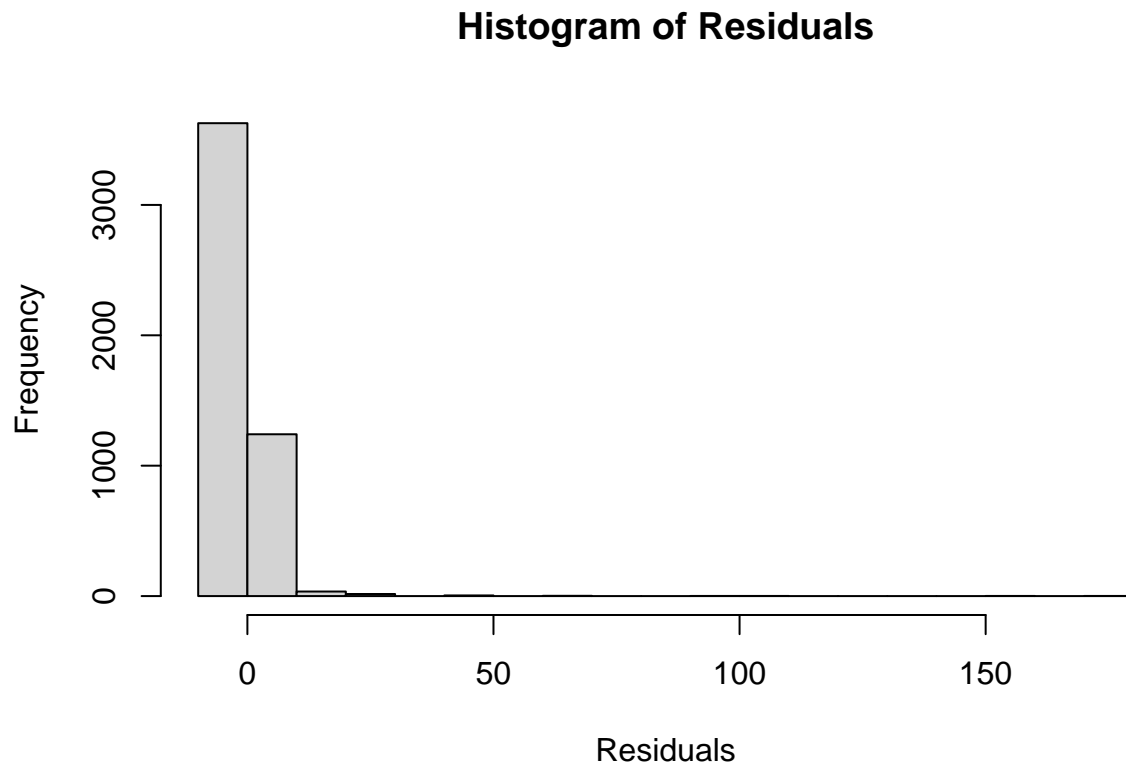
## [1] 4460.555

sum(residuals(mod3,'pearson')^2)

## [1] 5196.056

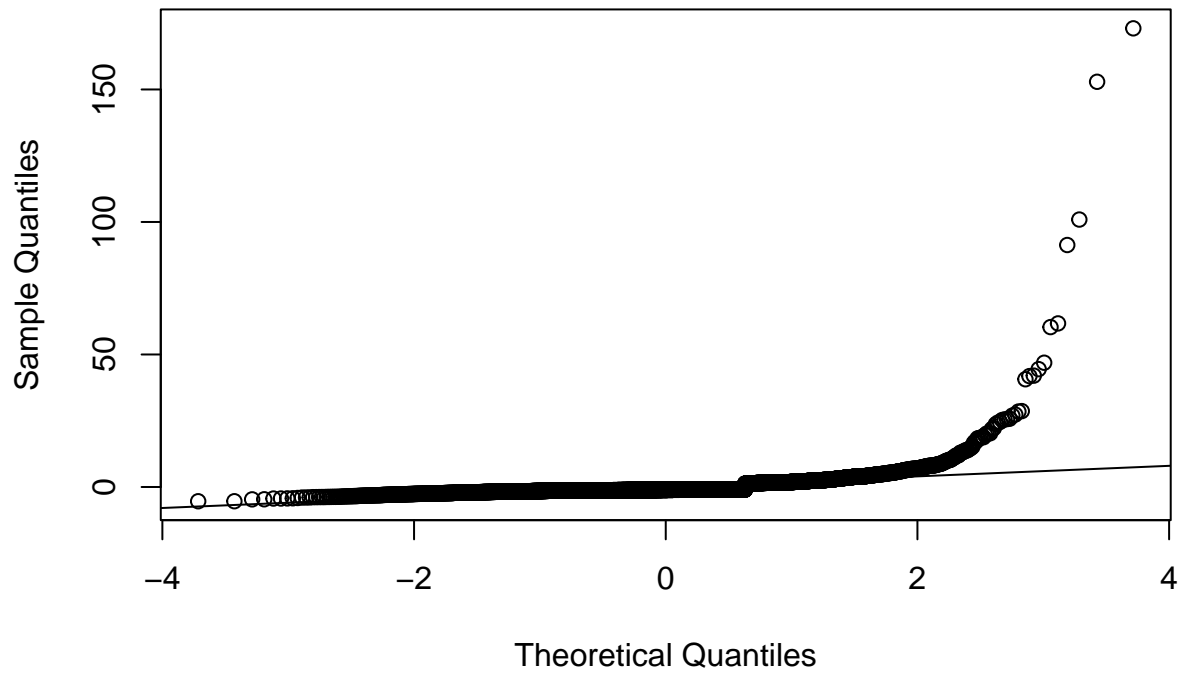
res_3 <- mod3$residuals

# Plotting a histogram of residuals
hist(res_3, main = "Histogram of Residuals", xlab = "Residuals")
```



```
# Q-Q plot for normality
qqnorm(res_3)
qqline(res_3)
```

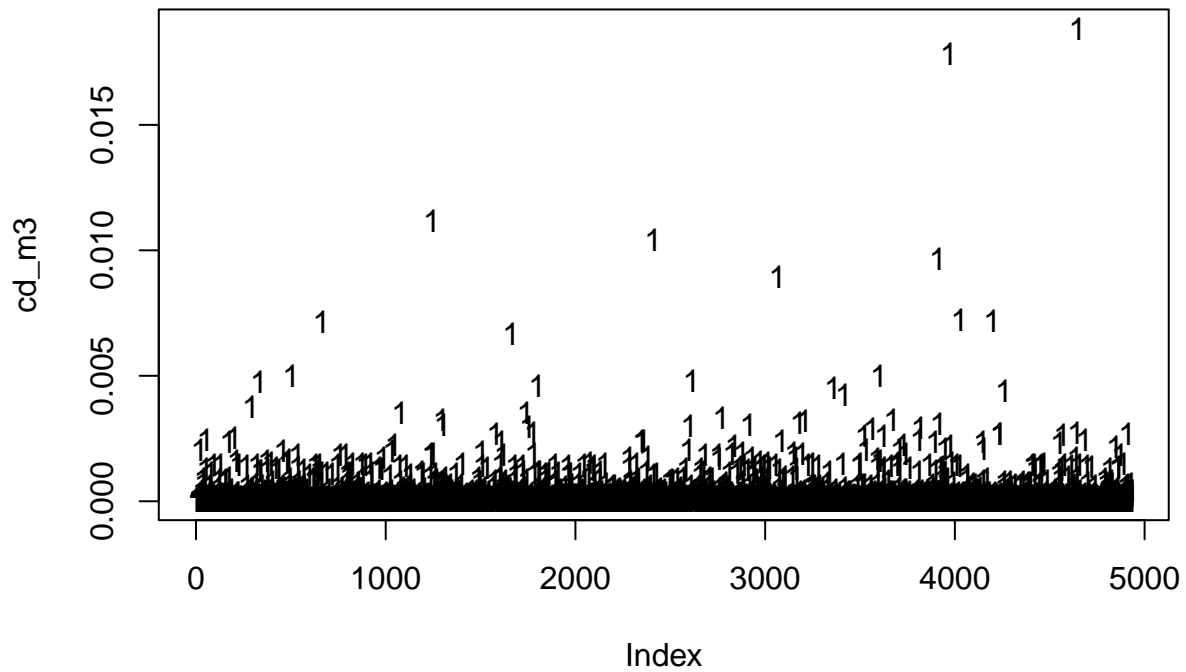
Normal Q-Q Plot



```
# Calculate Cook's distance
cd_m3 <- cooks.distance(mod3)

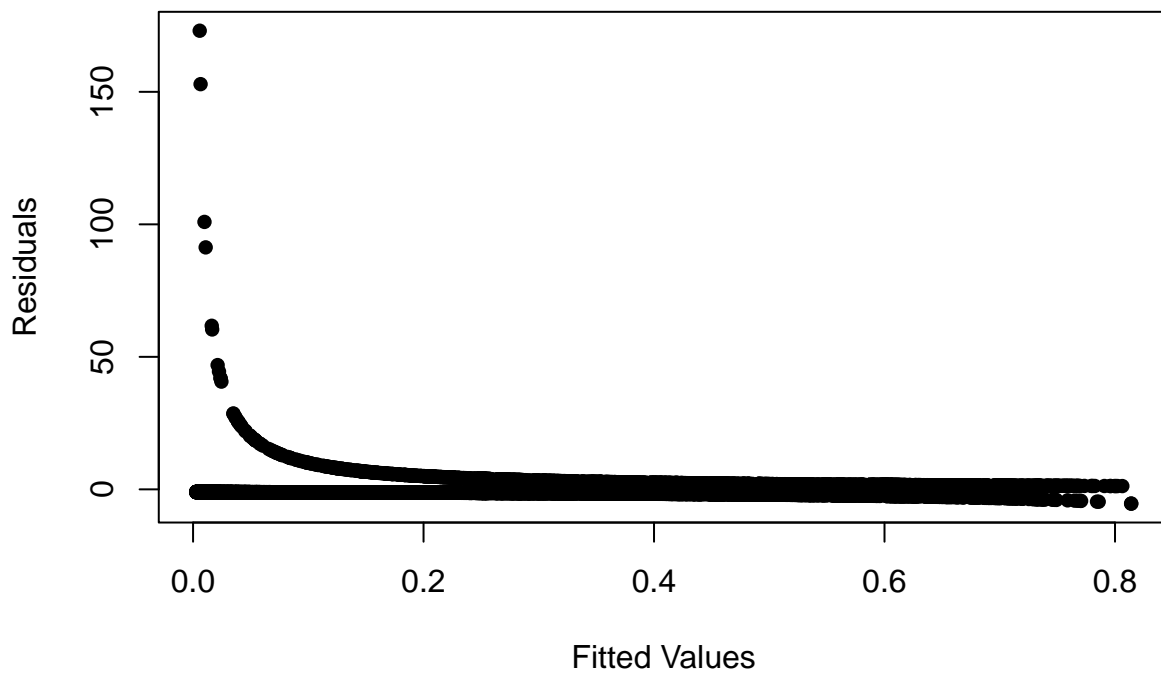
# Plot Cook's distance
plot(cd_m3, pch = "18", main = "Cook's Distance Plot")
abline(h = 4/(length(mod3$coefficients) - 1), col = "red")
```

Cook's Distance Plot



```
#Check homoscedasticity (constant variance of residuals) by plotting residuals against fitted values:
# Plotting residuals against fitted values
plot(fitted(mod3), res_3, pch = 16, main = "Residuals vs. Fitted Values", xlab = "Fitted Values", ylab = "Residuals")
```

Residuals vs. Fitted Values



##Categorical Variables

Now, we shall add the categorical variables. The order of addition is significant, therefore we start by adding the most correlated variables with the target.

Contract InternetService StreamingMovies StreamingTV TechSupport DeviceProtection OnlineBackup OnlineSecurity PaperlessBilling Dependents MultipleLines SeniorCitizen Partner PaymentMethod PhoneService

##Contract

We start with *Contract* variable.

```
mod4 <- glm(Churn ~ tenure + MonthlyCharges + Contract, data=train, family=binomial)
summary(mod4) #4302.2 better
```

```
##
## Call:
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract, family = binomial,
##      data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.7936  -0.7362  -0.3105   0.8171   3.2579
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   -1.687949   0.109108 -15.470  <2e-16 ***
## tenure        -0.035614   0.002450 -14.534  <2e-16 ***
## MonthlyCharges  0.029457   0.001632  18.047  <2e-16 ***
## ContractOne year -1.050590   0.120126  -8.746  <2e-16 ***
## ContractTwo year -2.082901   0.204897 -10.166  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4292.2  on 4925  degrees of freedom
## AIC: 4302.2
##
## Number of Fisher Scoring iterations: 6
```

```
anova(mod3, mod4, test="Chisq") #significant
```

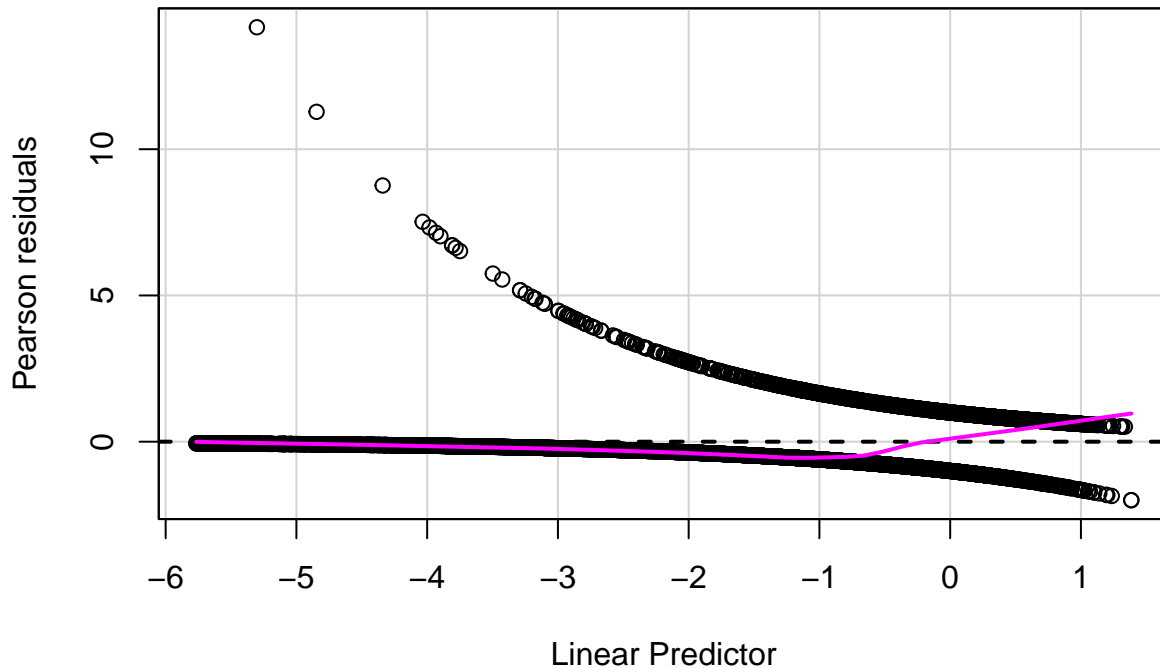
```
## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + MonthlyCharges + TotalCharges
## Model 2: Churn ~ tenure + MonthlyCharges + Contract
##      Resid. Df Resid. Dev Df Deviance  Pr(>Chi)
## 1      4926      4460.6
## 2      4925      4292.2  1   168.32 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
vif(mod4)
```

```
##              GVIF Df GVIF^(1/(2*Df))
## tenure        1.707900  1          1.306867
```



```
## MonthlyCharges 1.300967 1 1.140599
## Contract 1.361428 2 1.080186
```

```
residualPlot(mod4)
```



We

add the parameter because it improves the model.

```
##InternetService
```

```
mod5 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService, data=train, family=binomial)
summary(mod5) #4254.1 better
```

```
##
## Call:
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService,
##      family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.5883  -0.6894  -0.3084   0.8540   3.2009
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   -0.643248   0.186158  -3.455  0.00055 ***
## tenure        -0.032148   0.002479 -12.969 < 2e-16 ***
## MonthlyCharges  0.006365   0.003559   1.788  0.07373 .
## ContractOne year -0.865294   0.123069  -7.031 2.05e-12 ***
## ContractTwo year -1.804983   0.208329  -8.664 < 2e-16 ***
## InternetServiceFiber optic  0.980860   0.149013   6.582 4.63e-11 ***
## InternetServiceNo -0.895142   0.181620  -4.929 8.28e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
```

```
## Null deviance: 5694.2 on 4929 degrees of freedom
## Residual deviance: 4240.1 on 4923 degrees of freedom
## AIC: 4254.1
##
## Number of Fisher Scoring iterations: 6
```

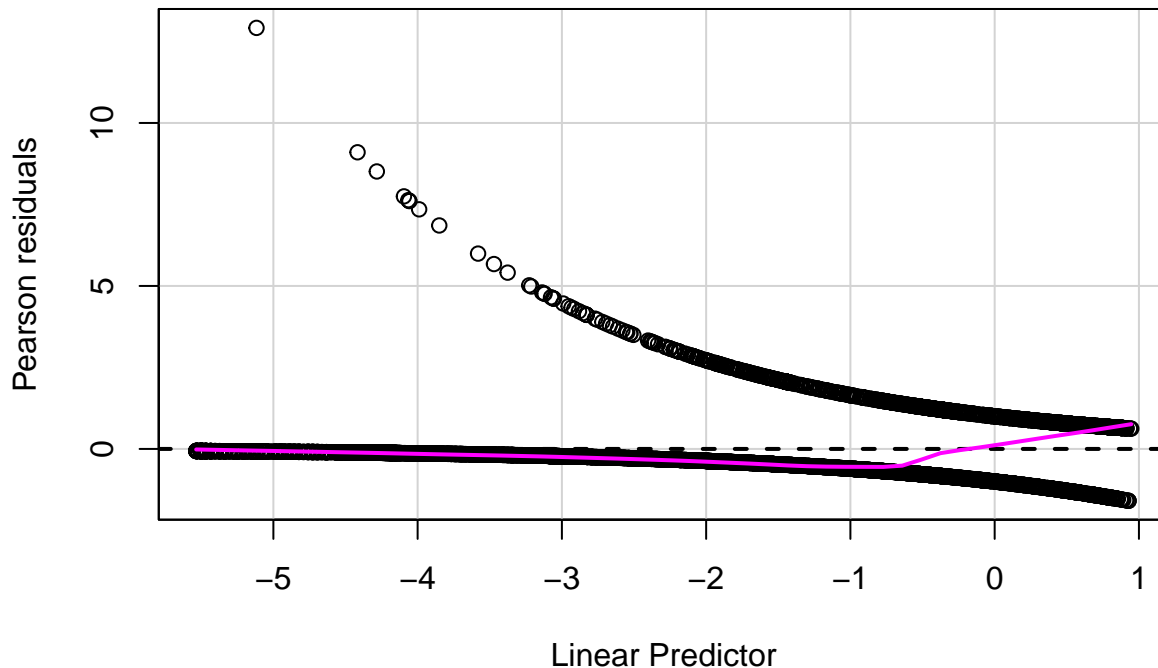
```
anova(mod4, mod5, test="Chisq") #significant
```

```
## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + MonthlyCharges + Contract
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService
## Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1 4925 4292.2
## 2 4923 4240.1 2 52.12 4.811e-12 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
vif(mod5)
```

```
## GVIF Df GVIF^(1/(2*Df))
## tenure 1.738643 1 1.318576
## MonthlyCharges 6.009378 1 2.451403
## Contract 1.450931 2 1.097518
## InternetService 5.338238 2 1.520021
```

```
residualPlot(mod5)
```



```
##StreamingMovies
```

```
mod6 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies, data=train,
summary(mod6) #4238.6 better
```

```
##
## Call:
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService +
```

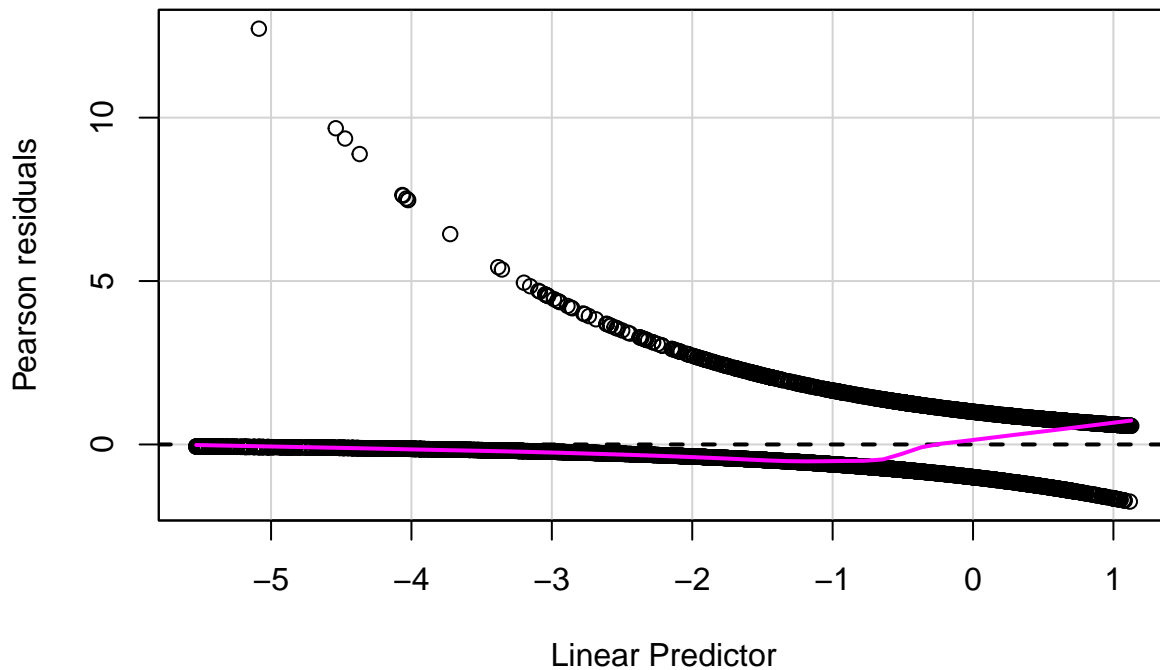
```

##      StreamingMovies, family = binomial, data = train)
##
## Deviance Residuals:
##      Min        1Q      Median        3Q        Max
## -1.6733  -0.6864  -0.3055   0.7973   3.1915
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -0.219913    0.209784  -1.048    0.295
## tenure         -0.031968    0.002480 -12.888 < 2e-16 ***
## MonthlyCharges  -0.004380    0.004374  -1.001    0.317
## ContractOne year -0.870117    0.123320  -7.056 1.72e-12 ***
## ContractTwo year -1.795490    0.208231  -8.623 < 2e-16 ***
## InternetServiceFiber optic 1.282307    0.167023   7.677 1.62e-14 ***
## InternetServiceNo -1.100410    0.186826  -5.890 3.86e-09 ***
## StreamingMoviesYes    0.441326    0.105641   4.178 2.95e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4222.6  on 4922  degrees of freedom
## AIC: 4238.6
##
## Number of Fisher Scoring iterations: 6
anova( mod5, mod6, test="Chisq") #significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##      StreamingMovies
##      Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1          4923      4240.1
## 2          4922      4222.6  1    17.563 2.78e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
vif(mod6)

##              GVIF Df GVIF^(1/(2*Df))
## tenure          1.734387  1      1.316961
## MonthlyCharges  9.114445  1      3.019014
## Contract        1.447519  2      1.096872
## InternetService 6.680296  2      1.607677
## StreamingMovies 1.878425  1      1.370556
residualPlot(mod6)

```



The

model has improved but the VIF is becoming higher.

```
##StreamingTV
```

```
mod7 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV, family = binomial, data = train)
summary(mod7) #4213.5 better
```

```
##
## Call:
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##       StreamingMovies + StreamingTV, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.7753  -0.6713  -0.3022   0.7769   3.1810
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    0.311672   0.230322   1.353 0.175990
## tenure        -0.031969   0.002487 -12.855 < 2e-16 ***
## MonthlyCharges -0.017752   0.005047  -3.517 0.000436 ***
## ContractOne year -0.870522   0.123651  -7.040 1.92e-12 ***
## ContractTwo year -1.775038   0.208250  -8.524 < 2e-16 ***
## InternetServiceFiber optic  1.650173   0.183107   9.012 < 2e-16 ***
## InternetServiceNo -1.359915   0.191532  -7.100 1.25e-12 ***
## StreamingMoviesYes  0.445782   0.105508   4.225 2.39e-05 ***
## StreamingTVYes    0.552871   0.106924   5.171 2.33e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4195.5  on 4921  degrees of freedom
```

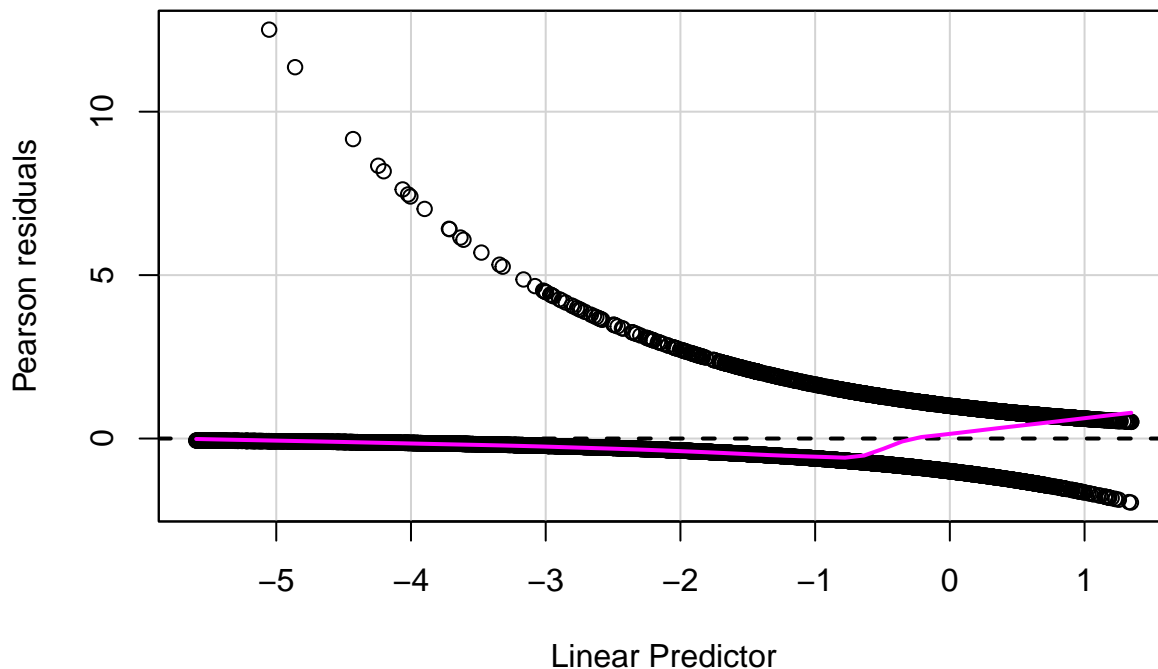
```
## AIC: 4213.5
##
## Number of Fisher Scoring iterations: 6
anova( mod6, mod7, test="Chisq") #significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##   StreamingMovies
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##   StreamingMovies + StreamingTV
##   Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1      4922      4222.6
## 2      4921      4195.5  1    27.002 2.033e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

vif(mod7)

##              GVIF Df GVIF^(1/(2*Df))
## tenure          1.732269  1      1.316157
## MonthlyCharges 12.166459  1      3.488045
## Contract        1.443988  2      1.096203
## InternetService  7.954251  2      1.679383
## StreamingMovies  1.860165  1      1.363878
## StreamingTV      1.906895  1      1.380904

residualPlot(mod7)
```



MonthlyCharges has a high VIF. We'll may need to add transformations or maybe discard this parameter. For now, we'll keep the parameters that we have been adding.

```
##TechSupport
```

```
mod8 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport)
#summary(mod8) #4208.3 better
AIC(mod8)
```

```
## [1] 4208.273
```

```
anova( mod7, mod8, test="Chisq") #significant
```

```
## Analysis of Deviance Table
```

```
##
```

```
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV
```

```
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport
```

```
## Resid. Df Resid. Dev Df Deviance Pr(>Chi)
```

```
## 1 4921 4195.5
```

```
## 2 4920 4188.3 1 7.2764 0.006987 **
```

```
## ---
```

```
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
vif(mod8)
```

```
## GVIF Df GVIF^(1/(2*Df))
```

```
## tenure 1.732344 1 1.316185
```

```
## MonthlyCharges 13.838376 1 3.719997
```

```
## Contract 1.475851 2 1.102201
```

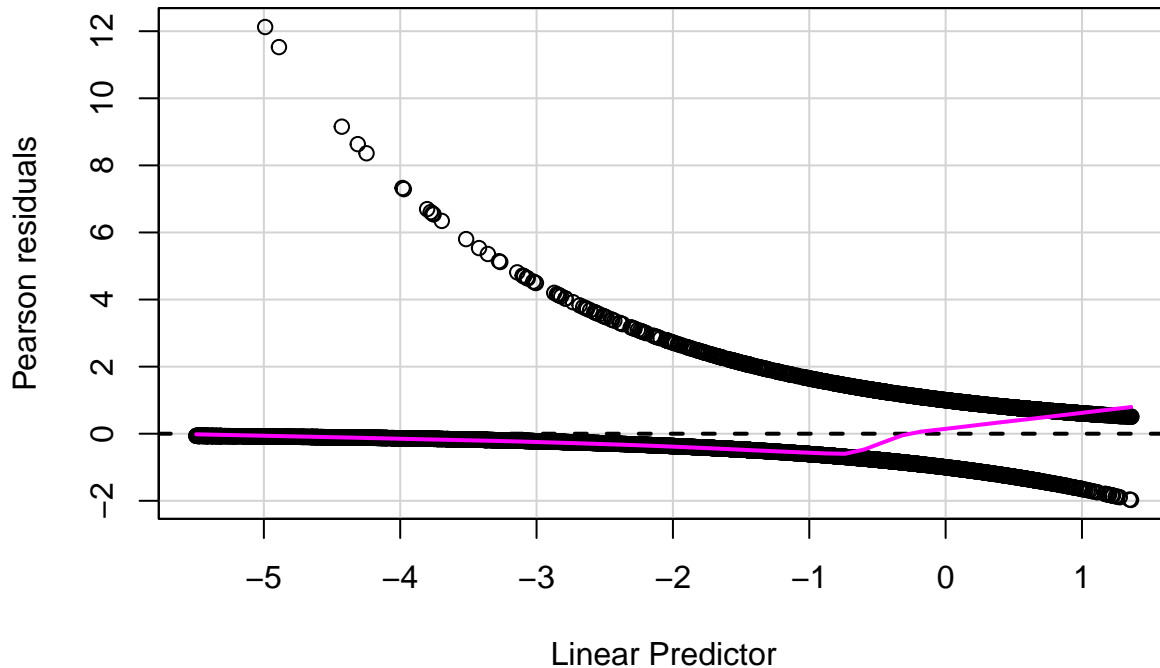
```
## InternetService 9.342986 2 1.748322
```

```
## StreamingMovies 1.893830 1 1.376165
```

```
## StreamingTV 1.943568 1 1.394119
```

```
## TechSupport 1.294163 1 1.137613
```

```
residualPlot(mod8)
```



Including *TechSupport* improves the model.

```
##DeviceProtection
```

```
mod9 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + DeviceProtection, data = train)
summary(mod9) #4209.3 worse
```

```
##
```

```
## Call:
```

```
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + DeviceProtection, family = binomial, data = train)
```

```
##
```

```
## Deviance Residuals:
```

```
##      Min       1Q   Median       3Q      Max
## -1.7717  -0.6683  -0.2984   0.7723   3.1679
```

```
##
```

```
## Coefficients:
```

```
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      0.20725    0.24332   0.852 0.394345
## tenure          -0.03217    0.00250 -12.868 < 2e-16 ***
## MonthlyCharges  -0.01417    0.00558  -2.539 0.011129 *
## ContractOne year -0.84846    0.12453  -6.813 9.54e-12 ***
## ContractTwo year -1.71130    0.21068  -8.123 4.55e-16 ***
## InternetServiceFiber optic  1.49636    0.20259   7.386 1.51e-13 ***
## InternetServiceNo -1.33473    0.19328  -6.906 5.00e-12 ***
## StreamingMoviesYes  0.41040    0.10661   3.850 0.000118 ***
## StreamingTVYes     0.51843    0.10817   4.793 1.64e-06 ***
## TechSupportYes    -0.27817    0.10447  -2.663 0.007751 **
## DeviceProtectionYes  0.09141    0.09477   0.965 0.334789
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
```

```
## (Dispersion parameter for binomial family taken to be 1)
```

```
##
```

```
##      Null deviance: 5694.2  on 4929  degrees of freedom
```

```
## Residual deviance: 4187.3  on 4919  degrees of freedom
```

```
## AIC: 4209.3
```

```
##
```

```
## Number of Fisher Scoring iterations: 6
```

```
AIC(mod9)
```

```
## [1] 4209.343
```

```
anova( mod8, mod9, test="Chisq") #not significant
```

```
## Analysis of Deviance Table
```

```
##
```

```
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport
```

```
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + DeviceProtection
```

```
##      Resid. Df Resid. Dev Df Deviance Pr(>Chi)
```

```
## 1      4920      4188.3
```

```
## 2      4919      4187.3  1  0.93092  0.3346
```

We don't add the parameter to the model. It does not improve it.

```
##OnlineBackup
```

```
mod10 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineBackup, data = train)
summary(mod10) #4209.6 worse
```

```
##
```

```
## Call:
```

```
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineBackup, family = binomial, data = train)
```

```
##
```

```
## Deviance Residuals:
```

```
##      Min       1Q   Median       3Q      Max
## -1.7803  -0.6674  -0.2993   0.7710   3.1670
```

```
##
```

```
## Coefficients:
```

```
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      0.208031   0.246005   0.846   0.3978
## tenure          -0.032365   0.002543 -12.725 < 2e-16 ***
## MonthlyCharges  -0.014254   0.005701  -2.500   0.0124 *
## ContractOne year -0.840426   0.124233  -6.765 1.33e-11 ***
## ContractTwo year -1.697207   0.210177  -8.075 6.74e-16 ***
## InternetServiceFiber optic 1.501499   0.206770   7.262 3.82e-13 ***
## InternetServiceNo -1.333854   0.193546  -6.892 5.51e-12 ***
## StreamingMoviesYes  0.421961   0.108219   3.899 9.65e-05 ***
## StreamingTVYes     0.528477   0.109739   4.816 1.47e-06 ***
## TechSupportYes    -0.274417   0.104746  -2.620   0.0088 **
## OnlineBackupYes    0.075863   0.094753   0.801   0.4233
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
```

```
## (Dispersion parameter for binomial family taken to be 1)
```

```
##
```

```
##      Null deviance: 5694.2  on 4929  degrees of freedom
```

```
## Residual deviance: 4187.6  on 4919  degrees of freedom
```

```
## AIC: 4209.6
```

```
##
```

```
## Number of Fisher Scoring iterations: 6
```

```
anova(mod8, mod10, test="Chisq") #not significant
```

```
## Analysis of Deviance Table
```

```
##
```

```
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport
```

```
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineBackup
```

```
##      Resid. Df Resid. Dev Df Deviance Pr(>Chi)
```

```
## 1      4920      4188.3
```

```
## 2      4919      4187.6  1  0.64158  0.4231
```

We don't add the parameter to the model. It does not improve it.

```
##OnlineSecurity
```

```
mod11 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineBackup, data = train)
summary(mod11) #4199 better
```



```
##
## Call:
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##       StreamingMovies + StreamingTV + TechSupport + OnlineSecurity,
##       family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.7735  -0.6638  -0.2979   0.7694   3.1416
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -0.008236    0.246066  -0.033 0.973301
## tenure         -0.031275    0.002499 -12.517 < 2e-16 ***
## MonthlyCharges -0.006781    0.005721  -1.185 0.235905
## ContractOne year -0.811442    0.124827  -6.501 8.00e-11 ***
## ContractTwo year -1.641703    0.211038  -7.779 7.30e-15 ***
## InternetServiceFiber optic  1.204840    0.210706   5.718 1.08e-08 ***
## InternetServiceNo -1.292005    0.194222  -6.652 2.89e-11 ***
## StreamingMoviesYes  0.339293    0.108944   3.114 0.001843 **
## StreamingTVYes     0.440566    0.110618   3.983 6.81e-05 ***
## TechSupportYes     -0.292683    0.104734  -2.795 0.005197 **
## OnlineSecurityYes  -0.352840    0.105394  -3.348 0.000815 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4177.0  on 4919  degrees of freedom
## AIC: 4199
##
## Number of Fisher Scoring iterations: 6
AIC(mod11)

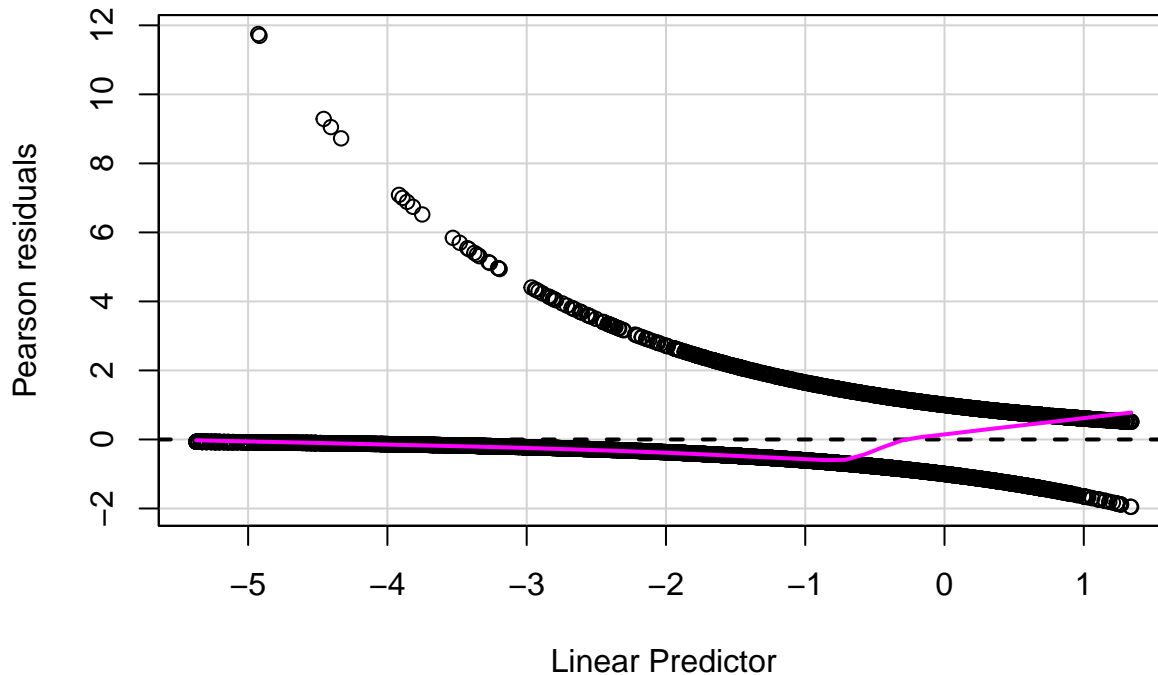
## [1] 4198.953
anova( mod8, mod11, test="Chisq") #significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##       StreamingMovies + StreamingTV + TechSupport
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##       StreamingMovies + StreamingTV + TechSupport + OnlineSecurity
##   Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1      4920      4188.3
## 2      4919      4177.0  1    11.321 0.0007665 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
vif(mod11)

##              GVIF Df GVIF^(1/(2*Df))
## tenure         1.744624  1          1.320842
```

```
## MonthlyCharges 15.487373 1      3.935400
## Contract       1.492903 2      1.105371
## InternetService 10.866851 2      1.815624
## StreamingMovies 1.971177 1      1.403986
## StreamingTV    2.028530 1      1.424265
## TechSupport    1.296059 1      1.138446
## OnlineSecurity 1.242751 1      1.114787
```

```
residualPlot(mod11)
```



We keep the parameter

```
##PaperlessBilling
```

```
mod12 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling, family = binomial, data = train)
summary(mod12) #4184.5 better
```

```
##
## Call:
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.8020  -0.6855  -0.2930   0.7658   3.1924
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   -0.206715   0.251517  -0.822  0.411150
## tenure        -0.031980   0.002512 -12.730 < 2e-16 ***
## MonthlyCharges -0.006893   0.005737  -1.202  0.229554
## ContractOne year -0.774511   0.125366  -6.178  6.49e-10 ***
## ContractTwo year -1.575801   0.211901  -7.436  1.03e-13 ***
```

```
## InternetServiceFiber optic 1.162390 0.211629 5.493 3.96e-08 ***
## InternetServiceNo -1.216241 0.195326 -6.227 4.76e-10 ***
## StreamingMoviesYes 0.328093 0.109142 3.006 0.002646 **
## StreamingTVYes 0.412453 0.111023 3.715 0.000203 ***
## TechSupportYes -0.293252 0.105072 -2.791 0.005255 **
## OnlineSecurityYes -0.325252 0.105781 -3.075 0.002107 **
## PaperlessBillingYes 0.354796 0.087670 4.047 5.19e-05 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 5694.2 on 4929 degrees of freedom
## Residual deviance: 4160.5 on 4918 degrees of freedom
## AIC: 4184.5
##
## Number of Fisher Scoring iterations: 6
```

```
AIC(mod12)
```

```
## [1] 4184.475
```

```
anova(mod11, mod12, test="Chisq") #significant
```

```
## Analysis of Deviance Table
```

```
##
```

```
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
```

```
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity
```

```
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
```

```
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
```

```
## PaperlessBilling
```

```
## Resid. Df Resid. Dev Df Deviance Pr(>Chi)
```

```
## 1 4919 4177.0
```

```
## 2 4918 4160.5 1 16.478 4.923e-05 ***
```

```
## ---
```

```
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
vif(mod12)
```

```
## GVIF Df GVIF^(1/(2*Df))
```

```
## tenure 1.760119 1 1.326695
```

```
## MonthlyCharges 15.519259 1 3.939449
```

```
## Contract 1.507661 2 1.108092
```

```
## InternetService 10.973792 2 1.820075
```

```
## StreamingMovies 1.970408 1 1.403712
```

```
## StreamingTV 2.035605 1 1.426746
```

```
## TechSupport 1.298079 1 1.139333
```

```
## OnlineSecurity 1.247294 1 1.116823
```

```
## PaperlessBilling 1.111928 1 1.054480
```

We keep the parameter

```
##Dependents
```

```
mod13 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling)
```

```
summary(mod13) #4177.2 better
```

```
##
```

```
## Call:
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##       StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##       PaperlessBilling + Dependents, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.8158  -0.6832  -0.2973   0.7559   3.1478
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -0.160331    0.252462  -0.635  0.52538
## tenure         -0.031654    0.002520 -12.559 < 2e-16 ***
## MonthlyCharges -0.006595    0.005749  -1.147  0.25137
## ContractOne year -0.746604    0.125870  -5.932 3.00e-09 ***
## ContractTwo year -1.536143    0.212595  -7.226 4.99e-13 ***
## InternetServiceFiber optic  1.133942    0.212173   5.344 9.07e-08 ***
## InternetServiceNo -1.193933    0.195766  -6.099 1.07e-09 ***
## StreamingMoviesYes  0.317729    0.109348   2.906  0.00366 **
## StreamingTVYes     0.412210    0.111213   3.706  0.00021 ***
## TechSupportYes     -0.287327    0.105193  -2.731  0.00631 **
## OnlineSecurityYes  -0.317077    0.105920  -2.994  0.00276 **
## PaperlessBillingYes  0.351625    0.087803   4.005 6.21e-05 ***
## DependentsYes     -0.291003    0.096298  -3.022  0.00251 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4151.2  on 4917  degrees of freedom
## AIC: 4177.2
##
## Number of Fisher Scoring iterations: 6
AIC(mod13)

## [1] 4177.206
anova( mod12, mod13, test="Chisq") #significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##       StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##       PaperlessBilling
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##       StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##       PaperlessBilling + Dependents
##      Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1         4918        4160.5
## 2         4917        4151.2  1    9.2692  0.00233 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
vif(mod13)
```

```
##              GVIF Df GVIF^(1/(2*Df))
## tenure          1.773404 1      1.331692
## MonthlyCharges  15.562560 1      3.944941
## Contract        1.522708 2      1.110847
## InternetService 10.992492 2      1.820849
## StreamingMovies  1.973305 1      1.404744
## StreamingTV      2.037770 1      1.427505
## TechSupport      1.299374 1      1.139901
## OnlineSecurity   1.247956 1      1.117120
## PaperlessBilling 1.112626 1      1.054811
## Dependents       1.027601 1      1.013706
```

We keep the parameter

```
##MultipleLines
```

```
mod14 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling + Dependents + MultipleLines, family = binomial, data = train)
summary(mod14) #4162.2 better
```

```
##
## Call:
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling + Dependents + MultipleLines, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.8679  -0.6758  -0.2959   0.7335   3.1636
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    0.325614  0.276930   1.176 0.239675
## tenure         -0.033818  0.002590 -13.059 < 2e-16 ***
## MonthlyCharges -0.019128  0.006487  -2.949 0.003190 **
## ContractOne year -0.708250  0.126272  -5.609 2.04e-08 ***
## ContractTwo year -1.505396  0.212577  -7.082 1.42e-12 ***
## InternetServiceFiber optic 1.425577  0.223890   6.367 1.92e-10 ***
## InternetServiceNo -1.452191  0.204587  -7.098 1.26e-12 ***
## StreamingMoviesYes  0.434506  0.113253   3.837 0.000125 ***
## StreamingTVYes     0.522217  0.114574   4.558 5.17e-06 ***
## TechSupportYes     -0.201538  0.107221  -1.880 0.060155 .
## OnlineSecurityYes  -0.241060  0.107617  -2.240 0.025093 *
## PaperlessBillingYes  0.337471  0.087923   3.838 0.000124 ***
## DependentsYes     -0.283338  0.096401  -2.939 0.003291 **
## MultipleLinesYes    0.422899  0.102860   4.111 3.93e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4134.2  on 4916  degrees of freedom
```

```
## AIC: 4162.2
##
## Number of Fisher Scoring iterations: 6
anova( mod13, mod14, test="Chisq") #significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##   StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##   PaperlessBilling + Dependents
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##   StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##   PaperlessBilling + Dependents + MultipleLines
##   Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1      4917      4151.2
## 2      4916      4134.2  1   17.026 3.688e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
vif(mod14)
```

```
##              GVIF Df GVIF^(1/(2*Df))
## tenure          1.860860  1      1.364133
## MonthlyCharges  19.785122  1      4.448047
## Contract        1.529039  2      1.112000
## InternetService 12.562934  2      1.882664
## StreamingMovies  2.104685  1      1.450753
## StreamingTV     2.150829  1      1.466570
## TechSupport     1.346109  1      1.160219
## OnlineSecurity   1.283323  1      1.132838
## PaperlessBilling 1.113149  1      1.055059
## Dependents       1.028391  1      1.014096
## MultipleLines    1.749163  1      1.322559
```

We keep the parameter

```
##SeniorCitizen
```

```
mod15 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling + Dependents + MultipleLines + SeniorCitizen, data = train, family = binomial)
summary(mod15) #4155.7 better
```

```
##
## Call:
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##   StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##   PaperlessBilling + Dependents + MultipleLines + SeniorCitizen,
##   family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.9542  -0.6697  -0.2944   0.7192   3.1729
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    0.267247   0.277985   0.961 0.336364
## tenure        -0.034666   0.002614 -13.260 < 2e-16 ***
```

```

## MonthlyCharges          -0.018721    0.006495   -2.883 0.003945 **
## ContractOne year        -0.687576    0.126551   -5.433 5.54e-08 ***
## ContractTwo year        -1.471829    0.212912   -6.913 4.75e-12 ***
## InternetServiceFiber optic 1.389895    0.224330    6.196 5.80e-10 ***
## InternetServiceNo       -1.414902    0.205187   -6.896 5.36e-12 ***
## StreamingMoviesYes       0.427058    0.113402    3.766 0.000166 ***
## StreamingTVYes          0.515559    0.114692    4.495 6.95e-06 ***
## TechSupportYes          -0.180640    0.107602   -1.679 0.093196 .
## OnlineSecurityYes       -0.227662    0.107759   -2.113 0.034627 *
## PaperlessBillingYes      0.330204    0.088016    3.752 0.000176 ***
## DependentsYes           -0.237905    0.097654   -2.436 0.014842 *
## MultipleLinesYes        0.409515    0.103119    3.971 7.15e-05 ***
## SeniorCitizen1          0.289328    0.099257    2.915 0.003558 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##    Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4125.7  on 4915  degrees of freedom
## AIC: 4155.7
##
## Number of Fisher Scoring iterations: 6
anova( mod14, mod15, test="Chisq") #significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##   StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##   PaperlessBilling + Dependents + MultipleLines
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##   StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##   PaperlessBilling + Dependents + MultipleLines + SeniorCitizen
##   Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1      4916      4134.2
## 2      4915      4125.7  1    8.4782 0.003594 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

vif(mod15)

##              GVIF Df GVIF^(1/(2*Df))
## tenure          1.889241  1      1.374497
## MonthlyCharges  19.790331  1      4.448632
## Contract         1.536772  2      1.113403
## InternetService  12.635139  2      1.885363
## StreamingMovies   2.104216  1      1.450592
## StreamingTV       2.148543  1      1.465791
## TechSupport       1.353673  1      1.163474
## OnlineSecurity    1.286526  1      1.134251
## PaperlessBilling  1.114284  1      1.055597
## Dependents        1.056349  1      1.027789
## MultipleLines     1.752169  1      1.323695
## SeniorCitizen     1.113813  1      1.055374

```

We keep the parameter

```
##Partner
```

```
mod16 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling + Dependents + MultipleLines + SeniorCitizen + Partner, family = binomial, data = train)
summary(mod16) #4157.7 worse
```

```
##
```

```
## Call:
```

```
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling + Dependents + MultipleLines + SeniorCitizen + Partner, family = binomial, data = train)
##
```

```
## Deviance Residuals:
```

```
##      Min       1Q   Median       3Q      Max
## -1.9523  -0.6695  -0.2944   0.7197   3.1749
```

```
##
```

```
## Coefficients:
```

```
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      0.265985    0.278118   0.956 0.338882
## tenure          -0.034758    0.002679 -12.975 < 2e-16 ***
## MonthlyCharges  -0.018728    0.006495  -2.883 0.003934 **
## ContractOne year -0.687576    0.126545  -5.433 5.53e-08 ***
## ContractTwo year -1.471574    0.212916  -6.912 4.79e-12 ***
## InternetServiceFiber optic  1.389752    0.224333   6.195 5.83e-10 ***
## InternetServiceNo -1.414725    0.205201  -6.894 5.41e-12 ***
## StreamingMoviesYes  0.426914    0.113407   3.764 0.000167 ***
## StreamingTVYes     0.515289    0.114703   4.492 7.04e-06 ***
## TechSupportYes    -0.180477    0.107609  -1.677 0.093512 .
## OnlineSecurityYes -0.227837    0.107764  -2.114 0.034496 *
## PaperlessBillingYes  0.330424    0.088026   3.754 0.000174 ***
## DependentsYes     -0.244710    0.106734  -2.293 0.021864 *
## MultipleLinesYes   0.409511    0.103119   3.971 7.15e-05 ***
## SeniorCitizen1     0.287578    0.099871   2.880 0.003983 **
## PartnerYes         0.014465    0.091544   0.158 0.874447
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
```

```
## (Dispersion parameter for binomial family taken to be 1)
```

```
##
```

```
##      Null deviance: 5694.2  on 4929  degrees of freedom
```

```
## Residual deviance: 4125.7  on 4914  degrees of freedom
```

```
## AIC: 4157.7
```

```
##
```

```
## Number of Fisher Scoring iterations: 6
```

```
anova(mod15, mod16, test="Chisq") #not significant
```

```
## Analysis of Deviance Table
```

```
##
```

```
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling + Dependents + MultipleLines + SeniorCitizen
```

```
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
```

```
##
```



```
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen +
## Partner
## Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1 4915 4125.7
## 2 4914 4125.7 1 0.024971 0.8744
```

We don't keep the parameter

```
##PaymentMethod
```

```
mod17 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling + Dependents + MultipleLines + SeniorCitizen + PaymentMethod, family = binomial, data = train)
summary(mod17) #4139.4 better
```

```
##
## Call:
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling + Dependents + MultipleLines + SeniorCitizen + PaymentMethod, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.9826  -0.6774  -0.2938   0.6992   3.1486
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      0.070752   0.297751   0.238 0.812174
## tenure          -0.033270   0.002671 -12.454 < 2e-16 ***
## MonthlyCharges  -0.017433   0.006529  -2.670 0.007580 **
## ContractOne year -0.660779   0.126880  -5.208 1.91e-07 ***
## ContractTwo year -1.426923   0.213449  -6.685 2.31e-11 ***
## InternetServiceFiber optic  1.293245   0.226310   5.714 1.10e-08 ***
## InternetServiceNo -1.304750   0.208471  -6.259 3.88e-10 ***
## StreamingMoviesYes  0.395594   0.113994   3.470 0.000520 ***
## StreamingTVYes     0.472452   0.115512   4.090 4.31e-05 ***
## TechSupportYes    -0.157729   0.108022  -1.460 0.144247
## OnlineSecurityYes -0.208169   0.108243  -1.923 0.054459 .
## PaperlessBillingYes  0.310428   0.088576   3.505 0.000457 ***
## DependentsYes     -0.224946   0.097913  -2.297 0.021595 *
## MultipleLinesYes   0.396569   0.103521   3.831 0.000128 ***
## SeniorCitizen1     0.264339   0.099866   2.647 0.008122 **
## PaymentMethodCredit card (automatic) -0.078607   0.135723  -0.579 0.562473
## PaymentMethodElectronic check  0.364430   0.113262   3.218 0.001293 **
## PaymentMethodMailed check  0.011420   0.136200   0.084 0.933179
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4103.4  on 4912  degrees of freedom
## AIC: 4139.4
##
## Number of Fisher Scoring iterations: 6
```

```
AIC(mod17)
```

```
## [1] 4139.434
```

```
anova( mod15, mod17, test="Chisq") #significant
```

```
## Analysis of Deviance Table
```

```
##
```

```
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
```

```
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
```

```
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen
```

```
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
```

```
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
```

```
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen +
```

```
## PaymentMethod
```

```
## Resid. Df Resid. Dev Df Deviance Pr(>Chi)
```

```
## 1 4915 4125.7
```

```
## 2 4912 4103.4 3 22.269 5.735e-05 ***
```

```
## ---
```

```
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
vif(mod17)
```

```
## GVIF Df GVIF^(1/(2*Df))
```

```
## tenure 1.963626 1 1.401295
```

```
## MonthlyCharges 19.895259 1 4.460410
```

```
## Contract 1.543913 2 1.114694
```

```
## InternetService 13.046889 2 1.900539
```

```
## StreamingMovies 2.110866 1 1.452882
```

```
## StreamingTV 2.164001 1 1.471054
```

```
## TechSupport 1.357356 1 1.165056
```

```
## OnlineSecurity 1.291867 1 1.136603
```

```
## PaperlessBilling 1.120742 1 1.058651
```

```
## Dependents 1.057502 1 1.028349
```

```
## MultipleLines 1.753352 1 1.324142
```

```
## SeniorCitizen 1.116591 1 1.056689
```

```
## PaymentMethod 1.332467 3 1.049001
```

```
##PhoneService
```

```
mod18 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling + Dependents + MultipleLines + SeniorCitizen + PaymentMethod + PhoneService, family = binomial, data = train)
```

```
summary(mod18) #4139.4 it does not change anything
```

```
##
```

```
## Call:
```

```
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService +
```

```
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
```

```
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen +
```

```
## PaymentMethod + PhoneService, family = binomial, data = train)
```

```
##
```

```
## Deviance Residuals:
```

```
## Min 1Q Median 3Q Max
```

```
## -1.9652 -0.6764 -0.2946 0.7022 3.1701
```

```
##
```

```
## Coefficients:
```

```
## Estimate Std. Error z value Pr(>|z|)
```

```
## (Intercept) -0.237709 0.366847 -0.648 0.516998
```

```
## tenure -0.034292 0.002768 -12.387 < 2e-16 ***
## MonthlyCharges -0.002716 0.012162 -0.223 0.823319
## ContractOne year -0.666781 0.126959 -5.252 1.51e-07 ***
## ContractTwo year -1.438924 0.213552 -6.738 1.61e-11 ***
## InternetServiceFiber optic 0.961078 0.323676 2.969 0.002985 **
## InternetServiceNo -0.865765 0.370693 -2.336 0.019516 *
## StreamingMoviesYes 0.236356 0.158998 1.487 0.137138
## StreamingTVYes 0.316047 0.158725 1.991 0.046463 *
## TechSupportYes -0.234653 0.120629 -1.945 0.051744 .
## OnlineSecurityYes -0.275385 0.118024 -2.333 0.019632 *
## PaperlessBillingYes 0.308580 0.088640 3.481 0.000499 ***
## DependentsYes -0.224714 0.097926 -2.295 0.021748 *
## MultipleLinesYes 0.336720 0.111645 3.016 0.002561 **
## SeniorCitizen1 0.259295 0.099923 2.595 0.009460 **
## PaymentMethodCredit card (automatic) -0.085694 0.135867 -0.631 0.528222
## PaymentMethodElectronic check 0.362532 0.113278 3.200 0.001373 **
## PaymentMethodMailed check 0.008268 0.136324 0.061 0.951640
## PhoneServiceYes -0.408196 0.284634 -1.434 0.151542
```

```
## ---
```

```
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
```

```
## (Dispersion parameter for binomial family taken to be 1)
```

```
##
```

```
## Null deviance: 5694.2 on 4929 degrees of freedom
```

```
## Residual deviance: 4101.4 on 4911 degrees of freedom
```

```
## AIC: 4139.4
```

```
##
```

```
## Number of Fisher Scoring iterations: 6
```

```
anova( mod17, mod18, test="Chisq") #not significant
```

```
## Analysis of Deviance Table
```

```
##
```

```
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
```

```
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
```

```
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen +
```

```
## PaymentMethod
```

```
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
```

```
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
```

```
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen +
```

```
## PaymentMethod + PhoneService
```

```
## Resid. Df Resid. Dev Df Deviance Pr(>Chi)
```

```
## 1 4912 4103.4
```

```
## 2 4911 4101.4 1 2.055 0.1517
```

```
###Interactions
```

We need to search for interactions. Possible interactions:

- Dependents and Multiple Lines

```
mod19 <- glm(Churn ~ tenure + MonthlyCharges + Contract + InternetService + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling + Dependents + MultipleLines + SeniorCitizen + PaymentMethod + PhoneService, data=churn, family=binomial)
summary(mod19) #4140.4 worse
```

```
##
```

```
## Call:
```

```
## glm(formula = Churn ~ tenure + MonthlyCharges + Contract + InternetService +
```

```

##      StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##      PaperlessBilling + Dependents * MultipleLines + SeniorCitizen +
##      PaymentMethod, family = binomial, data = train)
##
## Deviance Residuals:
##      Min        1Q    Median        3Q        Max
## -1.9914  -0.6708  -0.2929   0.6973   3.1546
##
## Coefficients:
##                                Estimate Std. Error z value Pr(>|z|)
## (Intercept)                   0.052152   0.298076   0.175 0.861108
## tenure                       -0.033288   0.002673 -12.452 < 2e-16 ***
## MonthlyCharges                -0.017353   0.006523  -2.660 0.007805 **
## ContractOne year             -0.660307   0.126854  -5.205 1.94e-07 ***
## ContractTwo year            -1.425823   0.213425  -6.681 2.38e-11 ***
## InternetServiceFiber optic    1.290777   0.226253   5.705 1.16e-08 ***
## InternetServiceNo           -1.304431   0.208303  -6.262 3.80e-10 ***
## StreamingMoviesYes           0.395038   0.113980   3.466 0.000529 ***
## StreamingTVYes               0.471360   0.115511   4.081 4.49e-05 ***
## TechSupportYes              -0.155875   0.108038  -1.443 0.149084
## OnlineSecurityYes           -0.210440   0.108257  -1.944 0.051909 .
## PaperlessBillingYes          0.310985   0.088566   3.511 0.000446 ***
## DependentsYes               -0.143040   0.125091  -1.143 0.252835
## MultipleLinesYes            0.437597   0.110848   3.948 7.89e-05 ***
## SeniorCitizen1              0.260630   0.099962   2.607 0.009126 **
## PaymentMethodCredit card (automatic) -0.079231   0.135761  -0.584 0.559483
## PaymentMethodElectronic check  0.361969   0.113331   3.194 0.001404 **
## PaymentMethodMailed check    0.009198   0.136248   0.068 0.946176
## DependentsYes:MultipleLinesYes -0.201472   0.194277  -1.037 0.299720
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4102.4  on 4911  degrees of freedom
## AIC: 4140.4
##
## Number of Fisher Scoring iterations: 6
AIC(mod19)

## [1] 4140.355
anova( mod17, mod19, test="Chisq") #not significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##      StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##      PaperlessBilling + Dependents + MultipleLines + SeniorCitizen +
##      PaymentMethod
## Model 2: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
##      StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##      PaperlessBilling + Dependents * MultipleLines + SeniorCitizen +

```

```
##      PaymentMethod
##      Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1         4912      4103.4
## 2         4911      4102.4  1    1.0787    0.299
```

We don't include the interaction since it is not significant

- MonthlyCharges and InternetService

```
mod20 <- glm(Churn ~ tenure + InternetService * MonthlyCharges + Contract + StreamingMovies + StreamingTV + TechSupport +
summary(mod20) #4133.7 better
```

```
##
## Call:
## glm(formula = Churn ~ tenure + InternetService * MonthlyCharges +
##      Contract + StreamingMovies + StreamingTV + TechSupport +
##      OnlineSecurity + PaperlessBilling + Dependents + MultipleLines +
##      SeniorCitizen + PaymentMethod, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.9939  -0.6755  -0.2942   0.6979   3.1435
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      0.375126   0.321672   1.166  0.243544
## tenure          -0.034642   0.002743 -12.631 < 2e-16
## InternetServiceFiber optic -0.077307   0.611334  -0.126  0.899370
## InternetServiceNo      1.574632   1.837650   0.857  0.391515
## MonthlyCharges    -0.021382   0.006719  -3.182  0.001460
## ContractOne year   -0.646656   0.127352  -5.078  3.82e-07
## ContractTwo year  -1.374625   0.214523  -6.408  1.48e-10
## StreamingMoviesYes  0.301368   0.121057   2.489  0.012793
## StreamingTVYes     0.378600   0.122216   3.098  0.001950
## TechSupportYes    -0.192043   0.109003  -1.762  0.078102
## OnlineSecurityYes  -0.233157   0.108835  -2.142  0.032170
## PaperlessBillingYes 0.319228   0.088765   3.596  0.000323
## DependentsYes     -0.216616   0.098105  -2.208  0.027244
## MultipleLinesYes   0.391234   0.107865   3.627  0.000287
## SeniorCitizen1     0.260591   0.099762   2.612  0.008998
## PaymentMethodCredit card (automatic) -0.078994   0.135960  -0.581  0.561235
## PaymentMethodElectronic check  0.365063   0.113381   3.220  0.001283
## PaymentMethodMailed check -0.015236   0.136746  -0.111  0.911284
## InternetServiceFiber optic:MonthlyCharges 0.017486   0.007265   2.407  0.016083
## InternetServiceNo:MonthlyCharges -0.150633   0.089703  -1.679  0.093104
##
## (Intercept)
## tenure ***
## InternetServiceFiber optic
## InternetServiceNo
## MonthlyCharges **
## ContractOne year ***
## ContractTwo year ***
## StreamingMoviesYes *
## StreamingTVYes **
## TechSupportYes .
```

```

## OnlineSecurityYes *
## PaperlessBillingYes ***
## DependentsYes *
## MultipleLinesYes ***
## SeniorCitizen1 **
## PaymentMethodCredit card (automatic)
## PaymentMethodElectronic check **
## PaymentMethodMailed check
## InternetServiceFiber optic:MonthlyCharges *
## InternetServiceNo:MonthlyCharges .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 5694.2 on 4929 degrees of freedom
## Residual deviance: 4093.7 on 4910 degrees of freedom
## AIC: 4133.7
##
## Number of Fisher Scoring iterations: 6
anova( mod17, mod20, test="Chisq") #significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen +
## PaymentMethod
## Model 2: Churn ~ tenure + InternetService * MonthlyCharges + Contract +
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen +
## PaymentMethod
## Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1 4912 4103.4
## 2 4910 4093.7 2 9.7694 0.007561 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
vif(mod20)

## there are higher-order terms (interactions) in this model
## consider setting type = 'predictor'; see ?vif

## GVIF Df GVIF^(1/(2*Df))
## tenure 2.079881 1 1.442179
## InternetService 9738.807709 2 9.934052
## MonthlyCharges 21.386127 1 4.624514
## Contract 1.550405 2 1.115864
## StreamingMovies 2.374759 1 1.541025
## StreamingTV 2.416906 1 1.554640
## TechSupport 1.374225 1 1.172273
## OnlineSecurity 1.300790 1 1.140522
## PaperlessBilling 1.124965 1 1.060644
## Dependents 1.056690 1 1.027954
## MultipleLines 1.897486 1 1.377493

```

```
## SeniorCitizen      1.115802  1      1.056315
## PaymentMethod      1.346214  3      1.050797
## InternetService:MonthlyCharges 11466.767397  2      10.348091
```

- SeniorCitizen and PaymentMethod

```
##
## Call:
## glm(formula = Churn ~ tenure + InternetService + MonthlyCharges +
##       Contract + StreamingMovies + StreamingTV + TechSupport +
##       OnlineSecurity + PaperlessBilling + Dependents + MultipleLines +
##       SeniorCitizen * PaymentMethod, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.9436  -0.6697  -0.2943   0.7051   3.1610
##
## Coefficients:
##                                     Estimate Std. Error
## (Intercept)                        0.141297   0.300816
## tenure                           -0.033374   0.002679
## InternetServiceFiber optic         1.282211   0.226985
## InternetServiceNo                  -1.272943   0.209319
## MonthlyCharges                     -0.017310   0.006552
## ContractOne year                   -0.657185   0.127109
## ContractTwo year                   -1.425156   0.213670
## StreamingMoviesYes                 0.401118   0.114247
## StreamingTVYes                     0.480398   0.115811
## TechSupportYes                    -0.160516   0.108364
## OnlineSecurityYes                  -0.210705   0.108492
## PaperlessBillingYes                0.313662   0.088759
## DependentsYes                     -0.232981   0.098228
## MultipleLinesYes                  0.402258   0.103847
## SeniorCitizen1                    -0.130083   0.241594
## PaymentMethodCredit card (automatic) -0.268973   0.153765
## PaymentMethodElectronic check      0.321001   0.126943
## PaymentMethodMailed check         -0.128290   0.146279
## SeniorCitizen1:PaymentMethodCredit card (automatic) 0.888203   0.332890
## SeniorCitizen1:PaymentMethodElectronic check      0.254924   0.271153
## SeniorCitizen1:PaymentMethodMailed check          0.981702   0.380207
##                                     z value Pr(>|z|)
## (Intercept)                        0.470 0.638560
## tenure                           -12.456 < 2e-16 ***
## InternetServiceFiber optic         5.649 1.62e-08 ***
## InternetServiceNo                  -6.081 1.19e-09 ***
## MonthlyCharges                     -2.642 0.008248 **
## ContractOne year                   -5.170 2.34e-07 ***
## ContractTwo year                   -6.670 2.56e-11 ***
## StreamingMoviesYes                 3.511 0.000446 ***
## StreamingTVYes                     4.148 3.35e-05 ***
```

```
## TechSupportYes -1.481 0.138534
## OnlineSecurityYes -1.942 0.052123 .
## PaperlessBillingYes 3.534 0.000410 ***
## DependentsYes -2.372 0.017700 *
## MultipleLinesYes 3.874 0.000107 ***
## SeniorCitizen1 -0.538 0.590277
## PaymentMethodCredit card (automatic) -1.749 0.080249 .
## PaymentMethodElectronic check 2.529 0.011448 *
## PaymentMethodMailed check -0.877 0.380476
## SeniorCitizen1:PaymentMethodCredit card (automatic) 2.668 0.007627 **
## SeniorCitizen1:PaymentMethodElectronic check 0.940 0.347141
## SeniorCitizen1:PaymentMethodMailed check 2.582 0.009822 **
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 5694.2 on 4929 degrees of freedom
## Residual deviance: 4091.0 on 4909 degrees of freedom
## AIC: 4133
##
## Number of Fisher Scoring iterations: 6
anova( mod17, mod21, test="Chisq") #significant
```

```
## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + MonthlyCharges + Contract + InternetService +
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen +
## PaymentMethod
## Model 2: Churn ~ tenure + InternetService + MonthlyCharges + Contract +
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen *
## PaymentMethod
## Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1 4912 4103.4
## 2 4909 4091.0 3 12.396 0.006144 **
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova( mod20, mod21, test="Chisq") #not significant
```

```
## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + InternetService * MonthlyCharges + Contract +
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen +
## PaymentMethod
## Model 2: Churn ~ tenure + InternetService + MonthlyCharges + Contract +
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen *
## PaymentMethod
## Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1 4910 4093.7
```



```
## 2      4909      4091.0  1   2.6261   0.1051
```

```
vif(mod21) #better multicollinearity
```

```
## there are higher-order terms (interactions) in this model
```

```
## consider setting type = 'predictor'; see ?vif
```

```
##                                GVIF Df GVIF^(1/(2*Df))
## tenure                        1.973899  1      1.404955
## InternetService               13.127210  2      1.903457
## MonthlyCharges                19.972402  1      4.469049
## Contract                      1.548154  2      1.115459
## StreamingMovies               2.114568  1      1.454155
## StreamingTV                   2.168544  1      1.472598
## TechSupport                   1.359278  1      1.165881
## OnlineSecurity                1.292280  1      1.136785
## PaperlessBilling              1.120630  1      1.058598
## Dependents                    1.058287  1      1.028731
## MultipleLines                 1.759302  1      1.326387
## SeniorCitizen                 6.564344  1      2.562098
## PaymentMethod                 2.413718  3      1.158193
## SeniorCitizen:PaymentMethod 10.225907  3      1.473274
```

```
mod22 <- glm(Churn ~ tenure + InternetService * MonthlyCharges + Contract + StreamingMovies + StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling + Dependents + MultipleLines + SeniorCitizen * PaymentMethod, family = binomial, data = train)
```

```
summary(mod22) #4126.8 better
```

```
##
```

```
## Call:
```

```
## glm(formula = Churn ~ tenure + InternetService * MonthlyCharges +
##      Contract + StreamingMovies + StreamingTV + TechSupport +
##      OnlineSecurity + PaperlessBilling + Dependents + MultipleLines +
##      SeniorCitizen * PaymentMethod, family = binomial, data = train)
```

```
##
```

```
## Deviance Residuals:
```

```
##      Min       1Q   Median       3Q      Max
## -1.9553  -0.6721  -0.2918   0.6985   3.1811
```

```
##
```

```
## Coefficients:
```

```
##                                Estimate Std. Error
## (Intercept)                   0.456138    0.325349
## tenure                       -0.034778    0.002752
## InternetServiceFiber optic    -0.115161    0.612924
## InternetServiceNo             1.691658    1.840678
## MonthlyCharges                -0.021370    0.006747
## ContractOne year              -0.642438    0.127587
## ContractTwo year              -1.371659    0.214758
## StreamingMoviesYes             0.305263    0.121349
## StreamingTVYes                 0.384985    0.122509
## TechSupportYes                -0.195397    0.109349
## OnlineSecurityYes             -0.235747    0.109076
## PaperlessBillingYes           0.322751    0.088957
## DependentsYes                 -0.224786    0.098426
## MultipleLinesYes              0.397526    0.108260
## SeniorCitizen1                -0.145982    0.241757
## PaymentMethodCredit card (automatic) -0.274207    0.154136
## PaymentMethodElectronic check  0.318908    0.127152
```

```

## PaymentMethodMailed check -0.159864 0.146983
## InternetServiceFiber optic:MonthlyCharges 0.017835 0.007286
## InternetServiceNo:MonthlyCharges -0.154986 0.089834
## SeniorCitizen1:PaymentMethodCredit card (automatic) 0.907214 0.333083
## SeniorCitizen1:PaymentMethodElectronic check 0.266655 0.271289
## SeniorCitizen1:PaymentMethodMailed check 1.002326 0.379973
## z value Pr(>|z|)
## (Intercept) 1.402 0.160917
## tenure -12.639 < 2e-16 ***
## InternetServiceFiber optic -0.188 0.850965
## InternetServiceNo 0.919 0.358074
## MonthlyCharges -3.167 0.001538 **
## ContractOne year -5.035 4.77e-07 ***
## ContractTwo year -6.387 1.69e-10 ***
## StreamingMoviesYes 2.516 0.011884 *
## StreamingTVYes 3.142 0.001675 **
## TechSupportYes -1.787 0.073952 .
## OnlineSecurityYes -2.161 0.030672 *
## PaperlessBillingYes 3.628 0.000285 ***
## DependentsYes -2.284 0.022383 *
## MultipleLinesYes 3.672 0.000241 ***
## SeniorCitizen1 -0.604 0.545951
## PaymentMethodCredit card (automatic) -1.779 0.075241 .
## PaymentMethodElectronic check 2.508 0.012139 *
## PaymentMethodMailed check -1.088 0.276756
## InternetServiceFiber optic:MonthlyCharges 2.448 0.014369 *
## InternetServiceNo:MonthlyCharges -1.725 0.084483 .
## SeniorCitizen1:PaymentMethodCredit card (automatic) 2.724 0.006456 **
## SeniorCitizen1:PaymentMethodElectronic check 0.983 0.325647
## SeniorCitizen1:PaymentMethodMailed check 2.638 0.008342 **
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 5694.2 on 4929 degrees of freedom
## Residual deviance: 4080.8 on 4907 degrees of freedom
## AIC: 4126.8
##
## Number of Fisher Scoring iterations: 6
anova( mod21, mod22, test="Chisq") #significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + InternetService + MonthlyCharges + Contract +
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen *
## PaymentMethod
## Model 2: Churn ~ tenure + InternetService * MonthlyCharges + Contract +
## StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
## PaperlessBilling + Dependents + MultipleLines + SeniorCitizen *
## PaymentMethod
## Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1 4909 4091.0

```

```
## 2      4907      4080.8  2   10.203 0.006088 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

anova(mod20, mod22, test="Chisq") #significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + InternetService * MonthlyCharges + Contract +
##   StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##   PaperlessBilling + Dependents + MultipleLines + SeniorCitizen +
##   PaymentMethod
## Model 2: Churn ~ tenure + InternetService * MonthlyCharges + Contract +
##   StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##   PaperlessBilling + Dependents + MultipleLines + SeniorCitizen *
##   PaymentMethod
##   Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1      4910      4093.7
## 2      4907      4080.8  3   12.829 0.005021 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

vif(mod22)
```

```
## there are higher-order terms (interactions) in this model
## consider setting type = 'predictor'; see ?vif
```

```
##
##               GVIF Df GVIF^(1/(2*Df))
## tenure                2.092433  1      1.446525
## InternetService      9747.368394  2      9.936235
## MonthlyCharges       21.496711  1      4.636455
## Contract              1.554570  2      1.116613
## StreamingMovies       2.379677  1      1.542620
## StreamingTV           2.420865  1      1.555913
## TechSupport           1.375906  1      1.172990
## OnlineSecurity        1.300799  1      1.140526
## PaperlessBilling      1.124887  1      1.060607
## Dependents            1.057390  1      1.028295
## MultipleLines         1.905667  1      1.380459
## SeniorCitizen         6.580622  1      2.565272
## PaymentMethod         2.445976  3      1.160759
## InternetService:MonthlyCharges 11487.448457  2      10.352754
## SeniorCitizen:PaymentMethod    10.277317  3      1.474506
```

```
#deviance(ngm4);ngm4$df.residual
#deviance(ngm6);ngm6$df.residual
#deviance(ngm4)-deviance(ngm6)
#((deviance(ngm4)-deviance(ngm6))/6)/1.1678
#1-pf(1.533252,6,53)
```

Having both interactions improves the model but VIF gets worse. The best model is with SeniorCitizen and PaymentMethod interaction (mod21)

```
###Second Order variable
```

```
mod23 <- glm(Churn ~ tenure + I(tenure^2) + InternetService + MonthlyCharges + Contract + StreamingMovies +
summary(mod23) #4088.4 better
```

```
##
## Call:
## glm(formula = Churn ~ tenure + I(tenure^2) + InternetService +
##     MonthlyCharges + Contract + StreamingMovies + StreamingTV +
##     TechSupport + OnlineSecurity + PaperlessBilling + Dependents +
##     MultipleLines + SeniorCitizen * PaymentMethod, family = binomial,
##     data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -2.0611  -0.6674  -0.2894   0.6499   3.2575
##
## Coefficients:
##                                     Estimate Std. Error
## (Intercept)                      0.5107106  0.3092170
## tenure                          -0.0771493  0.0070299
## I(tenure^2)                      0.0007065  0.0001032
## InternetServiceFiber optic       1.3144174  0.2305726
## InternetServiceNo               -1.3024378  0.2114289
## MonthlyCharges                   -0.0182734  0.0066490
## ContractOne year                 -0.7035302  0.1300795
## ContractTwo year                 -1.8604502  0.2303320
## StreamingMoviesYes               0.4269526  0.1157338
## StreamingTVYes                   0.5127531  0.1175811
## TechSupportYes                   -0.1235944  0.1090855
## OnlineSecurityYes                -0.1883864  0.1091173
## PaperlessBillingYes              0.3134114  0.0898515
## DependentsYes                   -0.2014632  0.0988339
## MultipleLinesYes                 0.4459449  0.1060891
## SeniorCitizen1                   -0.1252740  0.2393366
## PaymentMethodCredit card (automatic) -0.2599261  0.1536875
## PaymentMethodElectronic check     0.2743968  0.1276380
## PaymentMethodMailed check        -0.2024297  0.1486121
## SeniorCitizen1:PaymentMethodCredit card (automatic) 0.8146949  0.3291341
## SeniorCitizen1:PaymentMethodElectronic check     0.2817633  0.2695343
## SeniorCitizen1:PaymentMethodMailed check     1.0361353  0.3844824
##                                     z value Pr(>|z|)
## (Intercept)                      1.652 0.098611 .
## tenure                          -10.974 < 2e-16 ***
## I(tenure^2)                      6.844 7.70e-12 ***
## InternetServiceFiber optic       5.701 1.19e-08 ***
## InternetServiceNo               -6.160 7.27e-10 ***
## MonthlyCharges                   -2.748 0.005991 **
## ContractOne year                 -5.408 6.36e-08 ***
## ContractTwo year                 -8.077 6.62e-16 ***
## StreamingMoviesYes               3.689 0.000225 ***
## StreamingTVYes                   4.361 1.30e-05 ***
## TechSupportYes                   -1.133 0.257212
## OnlineSecurityYes                -1.726 0.084265 .
## PaperlessBillingYes              3.488 0.000486 ***
## DependentsYes                   -2.038 0.041510 *
## MultipleLinesYes                 4.203 2.63e-05 ***
## SeniorCitizen1                   -0.523 0.600681
## PaymentMethodCredit card (automatic) -1.691 0.090786 .
```

```

## PaymentMethodElectronic check                2.150 0.031571 *
## PaymentMethodMailed check                    -1.362 0.173155
## SeniorCitizen1:PaymentMethodCredit card (automatic) 2.475 0.013314 *
## SeniorCitizen1:PaymentMethodElectronic check      1.045 0.295852
## SeniorCitizen1:PaymentMethodMailed check          2.695 0.007041 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##    Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4044.4  on 4908  degrees of freedom
## AIC: 4088.4
##
## Number of Fisher Scoring iterations: 6
anova( mod21, mod23, test="Chisq") #significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + InternetService + MonthlyCharges + Contract +
##   StreamingMovies + StreamingTV + TechSupport + OnlineSecurity +
##   PaperlessBilling + Dependents + MultipleLines + SeniorCitizen *
##   PaymentMethod
## Model 2: Churn ~ tenure + I(tenure^2) + InternetService + MonthlyCharges +
##   Contract + StreamingMovies + StreamingTV + TechSupport +
##   OnlineSecurity + PaperlessBilling + Dependents + MultipleLines +
##   SeniorCitizen * PaymentMethod
##   Resid. Df Resid. Dev Df Deviance  Pr(>Chi)
## 1      4909      4091.0
## 2      4908      4044.4  1    46.672 8.392e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
vif(mod23)

## there are higher-order terms (interactions) in this model
## consider setting type = 'predictor'; see ?vif
##
##              GVIF Df GVIF^(1/(2*Df))
## tenure              15.110913  1      3.887276
## I(tenure^2)          14.413478  1      3.796509
## InternetService      13.143356  2      1.904042
## MonthlyCharges       20.658589  1      4.545172
## Contract              1.830861  2      1.163225
## StreamingMovies       2.155609  1      1.468199
## StreamingTV           2.220993  1      1.490300
## TechSupport           1.373947  1      1.172155
## OnlineSecurity        1.306102  1      1.142848
## PaperlessBilling      1.124076  1      1.060225
## Dependents            1.060211  1      1.029666
## MultipleLines         1.824384  1      1.350697
## SeniorCitizen         6.421969  1      2.534160
## PaymentMethod         2.503172  3      1.165239
## SeniorCitizen:PaymentMethod 10.118072  3      1.470674

```

```
mod23.1 <- glm(Churn ~ tenure + I(tenure^2) + InternetService + Contract + StreamingMovies + StreamingTV)
summary(mod23.1) #4093.9 worse
```

```
##
## Call:
## glm(formula = Churn ~ tenure + I(tenure^2) + InternetService +
##      Contract + StreamingMovies + StreamingTV + TechSupport +
##      OnlineSecurity + PaperlessBilling + Dependents + MultipleLines +
##      SeniorCitizen * PaymentMethod, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -2.0351  -0.6680  -0.2897   0.6449   3.2705
##
## Coefficients:
##                                     Estimate Std. Error
## (Intercept)                       -0.2266620  0.1556297
## tenure                           -0.0772783  0.0070216
## I(tenure^2)                        0.0007013  0.0001031
## InternetServiceFiber optic         0.7470363  0.0992282
## InternetServiceNo                  -0.9173866  0.1597837
## ContractOne year                   -0.7248815  0.1298952
## ContractTwo year                   -1.8789493  0.2307197
## StreamingMoviesYes                 0.2445740  0.0944671
## StreamingTVYes                     0.3265157  0.0957678
## TechSupportYes                     -0.2377202  0.1008359
## OnlineSecurityYes                  -0.2941833  0.1020655
## PaperlessBillingYes                0.3161947  0.0897272
## DependentsYes                     -0.2077444  0.0986981
## MultipleLinesYes                   0.3089745  0.0929888
## SeniorCitizen1                    -0.1292747  0.2389069
## PaymentMethodCredit card (automatic) -0.2615723  0.1535825
## PaymentMethodElectronic check      0.2821311  0.1274583
## PaymentMethodMailed check          -0.2022035  0.1484063
## SeniorCitizen1:PaymentMethodCredit card (automatic) 0.8216282  0.3286077
## SeniorCitizen1:PaymentMethodElectronic check      0.2920587  0.2690766
## SeniorCitizen1:PaymentMethodMailed check          1.0494607  0.3836744
##                                     z value Pr(>|z|)
## (Intercept)                       -1.456 0.145277
## tenure                           -11.006 < 2e-16 ***
## I(tenure^2)                        6.802 1.03e-11 ***
## InternetServiceFiber optic         7.528 5.13e-14 ***
## InternetServiceNo                  -5.741 9.39e-09 ***
## ContractOne year                   -5.581 2.40e-08 ***
## ContractTwo year                   -8.144 3.83e-16 ***
## StreamingMoviesYes                 2.589 0.009626 **
## StreamingTVYes                     3.409 0.000651 ***
## TechSupportYes                     -2.357 0.018399 *
## OnlineSecurityYes                  -2.882 0.003948 **
## PaperlessBillingYes                3.524 0.000425 ***
## DependentsYes                     -2.105 0.035305 *
## MultipleLinesYes                   3.323 0.000891 ***
## SeniorCitizen1                    -0.541 0.588432
## PaymentMethodCredit card (automatic) -1.703 0.088542 .
```

```

## PaymentMethodElectronic check                2.214 0.026862 *
## PaymentMethodMailed check                    -1.362 0.173040
## SeniorCitizen1:PaymentMethodCredit card (automatic) 2.500 0.012408 *
## SeniorCitizen1:PaymentMethodElectronic check      1.085 0.277740
## SeniorCitizen1:PaymentMethodMailed check          2.735 0.006233 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 5694.2 on 4929 degrees of freedom
## Residual deviance: 4051.9 on 4909 degrees of freedom
## AIC: 4093.9
##
## Number of Fisher Scoring iterations: 6
anova( mod23, mod23.1, test="Chisq") #significant

## Analysis of Deviance Table
##
## Model 1: Churn ~ tenure + I(tenure^2) + InternetService + MonthlyCharges +
## Contract + StreamingMovies + StreamingTV + TechSupport +
## OnlineSecurity + PaperlessBilling + Dependents + MultipleLines +
## SeniorCitizen * PaymentMethod
## Model 2: Churn ~ tenure + I(tenure^2) + InternetService + Contract + StreamingMovies +
## StreamingTV + TechSupport + OnlineSecurity + PaperlessBilling +
## Dependents + MultipleLines + SeniorCitizen * PaymentMethod
## Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1      4908      4044.4
## 2      4909      4051.9 -1  -7.5068 0.006147 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
vif(mod23.1) #better vif

## there are higher-order terms (interactions) in this model
## consider setting type = 'predictor'; see ?vif

##
## GVIF Df GVIF^(1/(2*Df))
## tenure                15.094283 1      3.885136
## I(tenure^2)            14.395726 1      3.794170
## InternetService        1.753349 2      1.150713
## Contract               1.832458 2      1.163479
## StreamingMovies        1.439408 1      1.199753
## StreamingTV            1.476549 1      1.215133
## TechSupport            1.176693 1      1.084755
## OnlineSecurity         1.145979 1      1.070504
## PaperlessBilling       1.123469 1      1.059938
## Dependents             1.059050 1      1.029102
## MultipleLines          1.406194 1      1.185831
## SeniorCitizen          6.416355 1      2.533052
## PaymentMethod          2.500773 3      1.165053
## SeniorCitizen:PaymentMethod 10.110887 3      1.470499

```

Removing *MonthlyCharges* from the model is getting a bit worse the AIC but the change is significant and it improves the VIF. We keep this last model.

```
###Predictions
```

```
#selecting the parameters that we have in the model
```

```
names(test)
```

```
## [1] "customerID"      "gender"           "SeniorCitizen"    "Partner"
## [5] "Dependents"      "tenure"           "PhoneService"     "MultipleLines"
## [9] "InternetService" "OnlineSecurity"   "OnlineBackup"     "DeviceProtection"
## [13] "TechSupport"     "StreamingTV"      "StreamingMovies"   "Contract"
## [17] "PaperlessBilling" "PaymentMethod"    "MonthlyCharges"   "TotalCharges"
## [21] "Churn"
```

```
test_data <- test[c(3,5,6,8,9,10,13,14,15,16,17,18)]
```

```
churn_pred<- ifelse(predict(mod23.1,newdat = test_data, type="response")>0.5,"Yes","No")
```

```
table(churn_pred)
```

```
## churn_pred
```

```
## No Yes
```

```
## 1695 418
```

```
table(test$Churn)
```

```
##
```

```
## No Yes
```

```
## 1547 566
```

```
#Confusion table
```

```
tt <- table(churn_pred, test$Churn);tt
```

```
##
```

```
## churn_pred No Yes
```

```
## No 1412 283
```

```
## Yes 135 283
```

```
100*sum(diag(tt))/sum(tt) #80.22
```

```
## [1] 80.2177
```

The accuracy of our model is good, it is 80.22.

Our final model is

```
summary(mod23.1)
```

```
##
```

```
## Call:
```

```
## glm(formula = Churn ~ tenure + I(tenure^2) + InternetService +
```

```
## Contract + StreamingMovies + StreamingTV + TechSupport +
```

```
## OnlineSecurity + PaperlessBilling + Dependents + MultipleLines +
```

```
## SeniorCitizen * PaymentMethod, family = binomial, data = train)
```

```
##
```

```
## Deviance Residuals:
```

```
## Min 1Q Median 3Q Max
```

```
## -2.0351 -0.6680 -0.2897 0.6449 3.2705
```

```
##
```

```
## Coefficients:
```

```
##
```

Estimate Std. Error


```

## (Intercept) -0.2266620 0.1556297
## tenure -0.0772783 0.0070216
## I(tenure^2) 0.0007013 0.0001031
## InternetServiceFiber optic 0.7470363 0.0992282
## InternetServiceNo -0.9173866 0.1597837
## ContractOne year -0.7248815 0.1298952
## ContractTwo year -1.8789493 0.2307197
## StreamingMoviesYes 0.2445740 0.0944671
## StreamingTVYes 0.3265157 0.0957678
## TechSupportYes -0.2377202 0.1008359
## OnlineSecurityYes -0.2941833 0.1020655
## PaperlessBillingYes 0.3161947 0.0897272
## DependentsYes -0.2077444 0.0986981
## MultipleLinesYes 0.3089745 0.0929888
## SeniorCitizen1 -0.1292747 0.2389069
## PaymentMethodCredit card (automatic) -0.2615723 0.1535825
## PaymentMethodElectronic check 0.2821311 0.1274583
## PaymentMethodMailed check -0.2022035 0.1484063
## SeniorCitizen1:PaymentMethodCredit card (automatic) 0.8216282 0.3286077
## SeniorCitizen1:PaymentMethodElectronic check 0.2920587 0.2690766
## SeniorCitizen1:PaymentMethodMailed check 1.0494607 0.3836744
## z value Pr(>|z|)
## (Intercept) -1.456 0.145277
## tenure -11.006 < 2e-16 ***
## I(tenure^2) 6.802 1.03e-11 ***
## InternetServiceFiber optic 7.528 5.13e-14 ***
## InternetServiceNo -5.741 9.39e-09 ***
## ContractOne year -5.581 2.40e-08 ***
## ContractTwo year -8.144 3.83e-16 ***
## StreamingMoviesYes 2.589 0.009626 **
## StreamingTVYes 3.409 0.000651 ***
## TechSupportYes -2.357 0.018399 *
## OnlineSecurityYes -2.882 0.003948 **
## PaperlessBillingYes 3.524 0.000425 ***
## DependentsYes -2.105 0.035305 *
## MultipleLinesYes 3.323 0.000891 ***
## SeniorCitizen1 -0.541 0.588432
## PaymentMethodCredit card (automatic) -1.703 0.088542 .
## PaymentMethodElectronic check 2.214 0.026862 *
## PaymentMethodMailed check -1.362 0.173040
## SeniorCitizen1:PaymentMethodCredit card (automatic) 2.500 0.012408 *
## SeniorCitizen1:PaymentMethodElectronic check 1.085 0.277740
## SeniorCitizen1:PaymentMethodMailed check 2.735 0.006233 **
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 5694.2 on 4929 degrees of freedom
## Residual deviance: 4051.9 on 4909 degrees of freedom
## AIC: 4093.9
##
## Number of Fisher Scoring iterations: 6

```

```
coef(mod23.1)
```

```
##              (Intercept)
##              -0.2266620396
##              tenure
##              -0.0772783387
##              I(tenure^2)
##              0.0007013327
##      InternetServiceFiber optic
##              0.7470363214
##      InternetServiceNo
##              -0.9173866311
##      ContractOne year
##              -0.7248814942
##      ContractTwo year
##              -1.8789492667
##      StreamingMoviesYes
##              0.2445740254
##      StreamingTVYes
##              0.3265156711
##      TechSupportYes
##              -0.2377201850
##      OnlineSecurityYes
##              -0.2941833258
##      PaperlessBillingYes
##              0.3161947338
##      DependentsYes
##              -0.2077443621
##      MultipleLinesYes
##              0.3089744501
##      SeniorCitizen1
##              -0.1292747211
##      PaymentMethodCredit card (automatic)
##              -0.2615723415
##      PaymentMethodElectronic check
##              0.2821310934
##      PaymentMethodMailed check
##              -0.2022034574
##      SeniorCitizen1:PaymentMethodCredit card (automatic)
##              0.8216281514
##      SeniorCitizen1:PaymentMethodElectronic check
##              0.2920586816
##      SeniorCitizen1:PaymentMethodMailed check
##              1.0494607462
```

$Y = -0.23 - 0.08tenure + 0.0007tenure^2 + 0.75InternetServiceFiberoptic - 0.92InternetServiceNo - 0.72ContractOneyear -$

Això ho podem posar a l'annex i deixem els comentaris al report

Univariate

```
names(train)
```

```
## [1] "customerID"      "gender"           "SeniorCitizen"    "Partner"
```

```
## [5] "Dependents"      "tenure"      "PhoneService" "MultipleLines"
## [9] "InternetService" "OnlineSecurity" "OnlineBackup" "DeviceProtection"
## [13] "TechSupport"     "StreamingTV"   "StreamingMovies" "Contract"
## [17] "PaperlessBilling" "PaymentMethod" "MonthlyCharges" "TotalCharges"
## [21] "Churn"
```

```
mod <- glm(Churn ~ gender, data=train, family=binomial)
summary(mod)
```

```
##
## Call:
## glm(formula = Churn ~ gender, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.7894  -0.7894  -0.7776   1.6235   1.6393
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept) -1.00637    0.04542 -22.158  <2e-16 ***
## genderMale  -0.03499    0.06460  -0.542   0.588
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5693.9  on 4928  degrees of freedom
## AIC: 5697.9
##
## Number of Fisher Scoring iterations: 4
```

```
mod2 <- glm(Churn ~ SeniorCitizen, data=train, family=binomial)
summary(mod2)
```

```
##
## Call:
## glm(formula = Churn ~ SeniorCitizen, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.0497  -0.7288  -0.7288   1.3107   1.7064
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -1.19026    0.03682 -32.33  <2e-16 ***
## SeniorCitizen1 0.88226    0.08027  10.99  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5577.9  on 4928  degrees of freedom
## AIC: 5581.9
```

```
##
## Number of Fisher Scoring iterations: 4
mod3 <- glm(Churn ~ Partner, data=train, family=binomial)
summary(mod3)

##
## Call:
## glm(formula = Churn ~ Partner, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.8946  -0.8946  -0.6573   1.4895   1.8102
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept) -0.70909    0.04215  -16.82  <2e-16 ***
## PartnerYes  -0.71326    0.06676  -10.68  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5576.5  on 4928  degrees of freedom
## AIC: 5580.5
##
## Number of Fisher Scoring iterations: 4
mod4 <- glm(Churn ~ Dependents, data=train, family=binomial)
summary(mod4)

##
## Call:
## glm(formula = Churn ~ Dependents, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.8682  -0.8682  -0.5642   1.5221   1.9577
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept) -0.78158    0.03662  -21.34  <2e-16 ***
## DependentsYes -0.97564    0.08228  -11.86  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5534.9  on 4928  degrees of freedom
## AIC: 5538.9
##
## Number of Fisher Scoring iterations: 4
```

```

mod5 <- glm(Churn ~ tenure, data=train, family=binomial)
summary(mod5)

##
## Call:
## glm(formula = Churn ~ tenure, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.1818  -0.8360  -0.4898   1.1893   2.3715
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  0.010348   0.050517   0.205    0.838
## tenure      -0.038339   0.001679 -22.837 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5040.7  on 4928  degrees of freedom
## AIC: 5044.7
##
## Number of Fisher Scoring iterations: 4

```

```

mod6 <- glm(Churn ~ PhoneService, data=train, family=binomial)
summary(mod6)

```

```

##
## Call:
## glm(formula = Churn ~ PhoneService, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.7876  -0.7876  -0.7876   1.6259   1.6844
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   -1.1415    0.1076 -10.611 <2e-16 ***
## PhoneServiceYes  0.1299    0.1128   1.151    0.25
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5692.9  on 4928  degrees of freedom
## AIC: 5696.9
##
## Number of Fisher Scoring iterations: 4

```

```

mod7 <- glm(Churn ~ MultipleLines, data=train, family=binomial)
summary(mod7)

```

```
##
## Call:
## glm(formula = Churn ~ MultipleLines, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.8283  -0.8283  -0.7504   1.5726   1.6763
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -1.12350    0.04348 -25.841 < 2e-16 ***
## MultipleLinesYes  0.23006    0.06505   3.537 0.000405 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5681.7  on 4928  degrees of freedom
## AIC: 5685.7
##
## Number of Fisher Scoring iterations: 4
mod8 <- glm(Churn ~ InternetService, data=train, family=binomial)
summary(mod8)

##
## Call:
## glm(formula = Churn ~ InternetService, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.0398  -1.0398  -0.6431   1.3215   2.3065
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -1.47098    0.06258 -23.506 <2e-16 ***
## InternetServiceFiber optic  1.13842    0.07611  14.957 <2e-16 ***
## InternetServiceNo    -1.11658    0.13582  -8.221 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5132.9  on 4927  degrees of freedom
## AIC: 5138.9
##
## Number of Fisher Scoring iterations: 5
mod9 <- glm(Churn ~ OnlineSecurity, data=train, family=binomial)
summary(mod9)

##
## Call:
```

```
## glm(formula = Churn ~ OnlineSecurity, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.8625  -0.8625  -0.5630   1.5292   1.9598
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   -0.79719    0.03633  -21.94  <2e-16 ***
## OnlineSecurityYes -0.96472    0.08405  -11.48  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5544.3  on 4928  degrees of freedom
## AIC: 5548.3
##
## Number of Fisher Scoring iterations: 4
```

```
mod10 <- glm(Churn ~ OnlineBackup, data=train, family=binomial)
summary(mod10)
```

```
##
## Call:
## glm(formula = Churn ~ OnlineBackup, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.8221  -0.8221  -0.7079   1.5805   1.7359
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   -0.91109    0.03891  -23.414  < 2e-16 ***
## OnlineBackupYes -0.34507    0.07016  -4.919 8.72e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5669.4  on 4928  degrees of freedom
## AIC: 5673.4
##
## Number of Fisher Scoring iterations: 4
```

```
mod11 <- glm(Churn ~ DeviceProtection, data=train, family=binomial)
summary(mod11)
```

```
##
## Call:
## glm(formula = Churn ~ DeviceProtection, family = binomial, data = train)
##
## Deviance Residuals:
```

```
##      Min      1Q   Median      3Q      Max
## -0.8147 -0.8147 -0.7228   1.5901   1.7148
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -0.93239    0.03909 -23.852 < 2e-16 ***
## DeviceProtectionYes -0.27669    0.06963  -3.973 7.09e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5678.1  on 4928  degrees of freedom
## AIC: 5682.1
##
## Number of Fisher Scoring iterations: 4
```

```
mod12 <- glm(Churn ~ TechSupport, data=train, family=binomial)
summary(mod12)
```

```
##
## Call:
## glm(formula = Churn ~ TechSupport, family = binomial, data = train)
##
## Deviance Residuals:
##      Min      1Q   Median      3Q      Max
## -0.8594 -0.8594 -0.5874   1.5331   1.9196
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   -0.80594    0.03674  -21.94 <2e-16 ***
## TechSupportYes -0.86397    0.08058  -10.72 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5566.6  on 4928  degrees of freedom
## AIC: 5570.6
##
## Number of Fisher Scoring iterations: 4
```

```
mod13 <- glm(Churn ~ StreamingTV, data=train, family=binomial)
summary(mod13)
```

```
##
## Call:
## glm(formula = Churn ~ StreamingTV, family = binomial, data = train)
##
## Deviance Residuals:
##      Min      1Q   Median      3Q      Max
## -0.8464 -0.8464 -0.7424   1.5495   1.6873
##
```



```
## Coefficients:
##           Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -1.14795    0.04263 -26.931 < 2e-16 ***
## StreamingTVYes  0.30561    0.06551   4.665 3.09e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##    Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5672.6  on 4928  degrees of freedom
## AIC: 5676.6
##
## Number of Fisher Scoring iterations: 4

mod14 <- glm(Churn ~ StreamingMovies, data=train, family=binomial)
summary(mod14)

##
## Call:
## glm(formula = Churn ~ StreamingMovies, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.8342  -0.8342  -0.7498   1.5650   1.6770
##
## Coefficients:
##           Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -1.12512    0.04254 -26.449 < 2e-16 ***
## StreamingMoviesYes  0.24849    0.06550   3.794 0.000148 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##    Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5679.9  on 4928  degrees of freedom
## AIC: 5683.9
##
## Number of Fisher Scoring iterations: 4

mod15 <- glm(Churn ~ Contract, data=train, family=binomial)
summary(mod15)

##
## Call:
## glm(formula = Churn ~ Contract, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.0490  -1.0490  -0.4923   1.3115   2.6944
##
## Coefficients:
##           Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -0.30975    0.03876  -7.992 1.33e-15 ***
```

```
## ContractOne year -1.73958    0.10521 -16.535 < 2e-16 ***
## ContractTwo year -3.29329    0.18611 -17.695 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 4736.2  on 4927  degrees of freedom
## AIC: 4742.2
##
## Number of Fisher Scoring iterations: 6
```

```
mod16 <- glm(Churn ~ PaperlessBilling, data=train, family=binomial)
summary(mod16)
```

```
##
## Call:
## glm(formula = Churn ~ PaperlessBilling, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.9003  -0.9003  -0.5994   1.4825   1.9001
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -1.62562    0.06013  -27.04  <2e-16 ***
## PaperlessBillingYes  0.93196    0.07182   12.98  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5512.4  on 4928  degrees of freedom
## AIC: 5516.4
##
## Number of Fisher Scoring iterations: 4
```

```
mod17 <- glm(Churn ~ PaymentMethod, data=train, family=binomial)
summary(mod17)
```

```
##
## Call:
## glm(formula = Churn ~ PaymentMethod, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.0988  -0.6466  -0.6073   1.2581   1.9537
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -1.59686    0.08266 -19.319  <2e-16 ***
## PaymentMethodCredit card (automatic) -0.15101    0.11847  -1.275   0.202
## PaymentMethodElectronic check      1.40923    0.09627  14.638  <2e-16 ***
```

```
## PaymentMethodMailed check          0.13813    0.11233    1.230    0.219
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5246.3  on 4926  degrees of freedom
## AIC: 5254.3
##
## Number of Fisher Scoring iterations: 4
```

```
mod18 <- glm(Churn ~ MonthlyCharges, data=train, family=binomial)
summary(mod18)
```

```
##
## Call:
## glm(formula = Churn ~ MonthlyCharges, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.0858  -0.8479  -0.6574   1.3652   1.9844
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -2.120267   0.090047  -23.55  <2e-16 ***
## MonthlyCharges  0.016008   0.001166   13.73  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 5694.2  on 4929  degrees of freedom
## Residual deviance: 5491.4  on 4928  degrees of freedom
## AIC: 5495.4
##
## Number of Fisher Scoring iterations: 4
```

```
mod19 <- glm(Churn ~ TotalCharges, data=train, family=binomial)
summary(mod19)
```

```
##
## Call:
## glm(formula = Churn ~ TotalCharges, family = binomial, data = train)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.9463  -0.8675  -0.6810   1.4321   2.2323
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -5.713e-01  4.451e-02  -12.84  <2e-16 ***
## TotalCharges -2.257e-04  1.726e-05  -13.07  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##  
## (Dispersion parameter for binomial family taken to be 1)  
##  
##      Null deviance: 5694.2  on 4929  degrees of freedom  
## Residual deviance: 5494.9  on 4928  degrees of freedom  
## AIC: 5498.9  
##  
## Number of Fisher Scoring iterations: 4  
AIC(mod)  
## [1] 5697.925
```