

# WriteUp\_D208\_V2

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## Part I: Research Question

“What factors impact customer tenure?”

**A1.** The average customer Tenure is 35.5 months or 2.88 years I will investigate the factors that impact customer tenure since letting a customer go rather than retaining them can be a significant detriment to the company's profit, as noted by Amy Gallo of Harvard Business Review: “...acquiring a new customer is anywhere from five to 25 times more expensive than retaining an existing one” (**Gallo, 2014**).

**A2.** This analysis aims to create a multiple linear regression model that will assist in predicting customer tenure. Knowing the factors that increase or decrease the customer's tenure will help the executives make data-informed decisions that will benefit the company and keep the customer happy.

## Part II: Method Justification

**B1.** There are four assumptions of linear regression (**Z. Bobbit, 2020**).

1. A linear relationship exists between the dependent and independent variables.
2. The residuals follow a normal distribution.
3. The residuals are homoscedastic. In other words, the residual plot should not show any signs of a pattern.
4. The residuals are independent. The residuals cannot be dependent on the surrounding points. While there are only four assumptions to a linear model, other factors must be considered (**G. Martin, n.d.**).
  1. Multi-collinearity should be minimized so that multiple variables do not tell the same story. Multi-collinearity occurs when the independent variables are correlated with each other.
  2. Outliers of residuals. Residuals can have high leverage and outside of 2 standard deviations, meaning that they have a large impact on the coefficients of the data and are outliers. Just like any other outlier, these outliers should be investigated further to determine if they should be removed or retained.

**B2.** I will be using R within R-Studio to perform this analysis. While Python can perform this same statistical analysis, it was not explicitly designed for this purpose. R, on the other hand, was specifically designed for statistical analysis (**Ihaka, n.d., p. 12**). Due to this, R is the more logical choice for performing statistical tasks. Secondly, I have more experience using R than I do with python. Ive used R to complete previous courses and I feel that it is more intuitive than python.

**B3.** Tenure is a continuous variable representing the months a customer has been with the company, making it a valuable metric for understanding customer retention. Tenure can be influenced by numerous numeric and categorical variables simultaneously making multiple regression a viable option to consider assuming all of the

assumptions in B1 are met.

## Part III: Data Preparation

**C1.** I need to remove irrelevant columns such as `customer_id`, `CaseOrder`, and some other columns that have data not relevant to my question. Secondly I have to update the data types. The Categorical variables will be converted to factors and the remaining quantitative variables will be converted to integer or numeric depending on the values. Once I have all the data cleaned and prepared I'll be ready to feed it into an initial linear model.

**C2.** The dependent variable I'm explaining is 'Tenure.' After I removed several columns of data that had too many unique entries or contained irrelevant information, such as `customer id`, or `lat` and `lng`, I was left with around 70 independent variables, including the automatically generated dummy variables.

The numeric and integer types all include a min, 1st Qu, Median, Mean, 3rd Qu, and Max values whereas the factors include just the count for each level. The summary statistics below show all of the variables including the dependant variable, that I will be using in my linear model. I will explain how I ended up with these variables in the next few sections.

```
summary(churn)
```

```

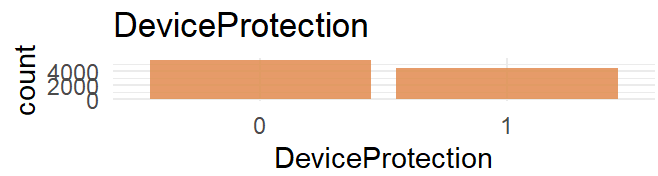
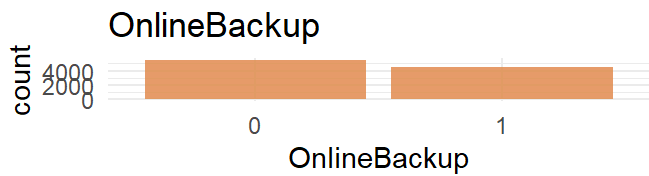
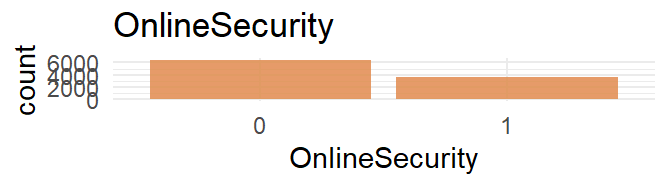
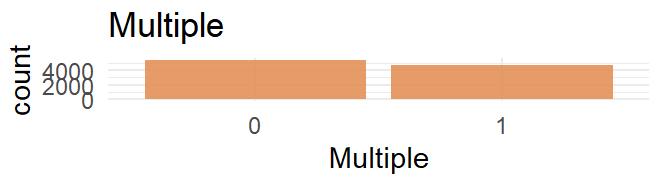
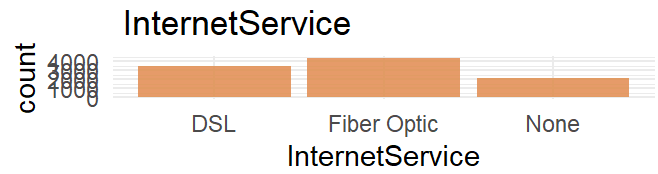
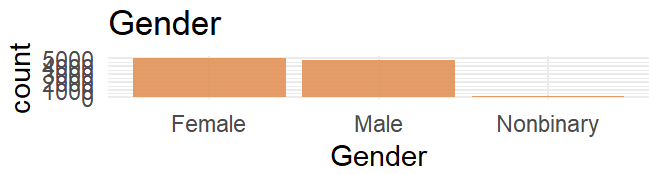
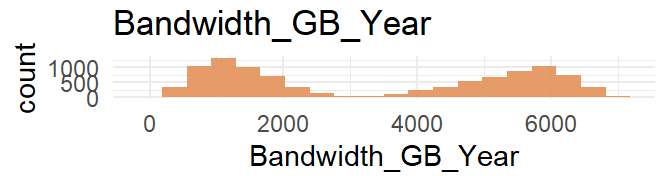
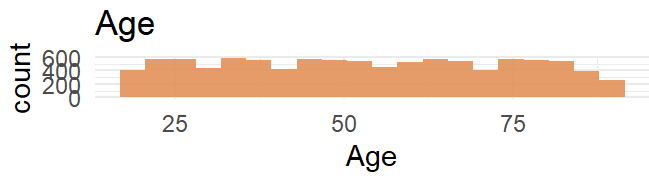
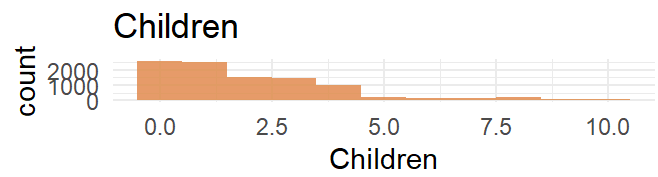
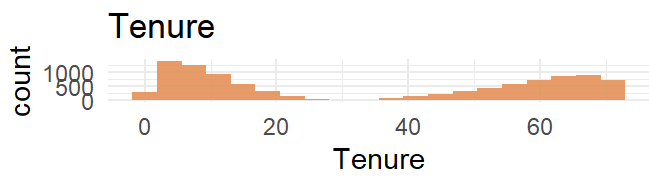
##      Population      Area      Children      Age
##  Min.   :    0   Rural   :3327   Min.   : 0.000   Min.   :18.00
##  1st Qu.:  738   Suburban:3346   1st Qu.: 0.000   1st Qu.:35.00
##  Median : 2910   Urban   :3327   Median : 1.000   Median :53.00
##  Mean   : 9757                      Mean   : 2.088   Mean   :53.08
##  3rd Qu.:13168                      3rd Qu.: 3.000   3rd Qu.:71.00
##  Max.   :111850                      Max.   :10.000   Max.   :89.00
##
##      Income      Marital      Gender      Churn
##  Min.   :  348.7   Divorced   :2092   Female   :5025   0:7350
##  1st Qu.:19224.7   Married    :1911   Male     :4744   1:2650
##  Median : 33170.6   Never Married:1956   Nonbinary: 231
##  Mean   : 39806.9   Separated   :2014
##  3rd Qu.: 53246.2   Widowed     :2027
##  Max.   :258900.7
##
##  Outage_sec_perweek   Email      Contacts      Yearly_equip_failure
##  Min.   : 0.09975   Min.   : 1.00   Min.   :0.0000   Min.   :0.000
##  1st Qu.: 8.01821   1st Qu.:10.00   1st Qu.:0.0000   1st Qu.:0.000
##  Median :10.01856   Median :12.00   Median :1.0000   Median :0.000
##  Mean   :10.00185   Mean   :12.02   Mean   :0.9942   Mean   :0.398
##  3rd Qu.:11.96949   3rd Qu.:14.00   3rd Qu.:2.0000   3rd Qu.:1.000
##  Max.   :21.20723   Max.   :23.00   Max.   :7.0000   Max.   :6.000
##
##  Techie      Contract   Port_modem Tablet      InternetService Phone
##  0:8321   Month-to-month:5456   0:5166   0:7009   DSL      :3463   0: 933
##  1:1679   One year      :2102   1:4834   1:2991   Fiber Optic:4408   1:9067
##          Two Year      :2442                      None      :2129
##
##
##
##
##  Multiple OnlineSecurity OnlineBackup DeviceProtection TechSupport StreamingTV
##  0:5392   0:6424      0:5494      0:5614      0:6250      0:5071
##  1:4608   1:3576      1:4506      1:4386      1:3750      1:4929
##
##
##
##
##  StreamingMovies PaperlessBilling      PaymentMethod
##  0:5110      0:4118      Bank Transfer(automatic):2229
##  1:4890      1:5882      Credit Card (automatic) :2083
##          Electronic Check      :3398
##          Mailed Check      :2290
##
##
##
##  Tenure      MonthlyCharge      Bandwidth_GB_Year Timely_response
##  Min.   : 1.000   Min.   : 79.98   Min.   : 155.5   1: 224
##  1st Qu.: 7.918   1st Qu.:139.98   1st Qu.:1236.5   2:1393
##  Median :35.431   Median :167.48   Median :3279.5   3:3448

```

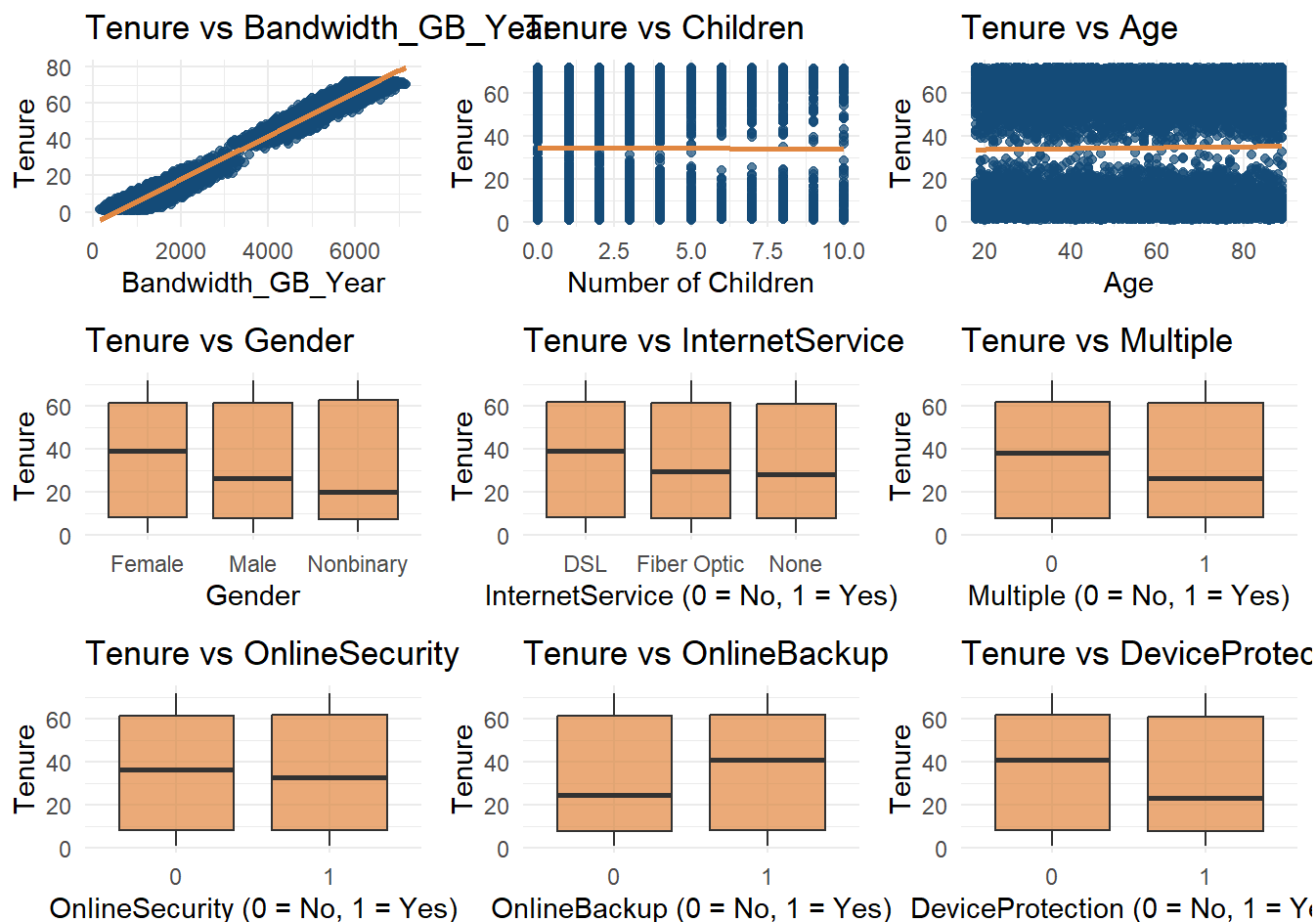
```
## Mean      :34.526    Mean      :172.62    Mean      :3392.3    4:3358
## 3rd Qu.:61.480    3rd Qu.:200.73    3rd Qu.:5586.1    5:1359
## Max.      :71.999    Max.      :290.16    Max.      :7159.0    6: 199
##                                                    7:  19
## Timely_fixes Timely_replacements Reliability Options    Respectful    Courteous
## 1: 217        3          :3435        1: 221        1: 206    3          :3445    1: 219
## 2:1360        4          :3410        2:1350        2:1378    4          :3333    2:1309
## 3:3415        2          :1424        3:3430        3:3462    2          :1427    3:3446
## 4:3412        5          :1313        4:3452        4:3417    5          :1382    4:3456
## 5:1368        6          : 203        5:1335        5:1321    6          : 210    5:1335
## 6: 215        1          : 202        6: 203        6: 204    1          : 190    6: 224
## 7: 13         (Other): 13         7:  9         7: 12    (Other): 13    7: 11
## Active_listening
## 3          :3461
## 4          :3400
## 2          :1378
## 5          :1335
## 1          : 206
## 6          : 205
## (Other): 15
```

**C3.** After running stepwise model selection based on the Akaike Information Criterion (AIC) and Backward elimination, I was left with far fewer variables than the initial model that included over 70 variables. I eliminated more using VIF(), which I will explain later. The following charts are the distributions of the variables I included in the final “updated\_model.”

Univariate Distribution Plots:



Bivariate Distribution Plots:



**C4.** To begin with I will check for na values and duplicates. For linear regression to work properly I needed to make sure all the data is the appropriate type. To do this I will be converting the survey responses to 'factor' while changing the names of the survey columns to be more intuitive. Next I will convert the remaining categorical columns to factors and the quantitative columns will be converted to integer or numeric depending on the values.

I need to drop irrelevant columns and convert data types to more appropriate ones to prepare the data. Some categorical variables have more than 8000 unique entries, which will also be dropped. I will not create any dummy variables because R automatically creates dummy variables or indicator variables in the linear model when a categorical variable is passed into the left of the "~", so long as the categorical variable is a factor datatype (Çetinkaya-Rundel et al., 2021).

**C5.** The prepared data set will be included in the uploaded documents. I have named it "CLEANED\_churn.csv."

Part IV: Model Comparison and Analysis

## Part IV: Model Comparison and Analysis

**D1.** I created an initial model using all the variables mentioned in C2 by using the "~ ., data = churn" method. Using a "." to the right of the tilde will include all variables in the data set.

```
summary(Initial_model1)
```

```
##
## Call:
## lm(formula = Tenure ~ ., data = training_set)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.15449 -0.10738  0.07453  0.10508  0.16148
##
## Coefficients:
##              Estimate Std. Error  t value Pr(>|t|)
## (Intercept)   -3.836e+00  2.854e-02  -134.392 < 2e-16
## Population    -2.747e-09  8.908e-08   -0.031  0.97540
## AreaSuburban  -9.197e-03  3.169e-03   -2.903  0.00371
## AreaUrban     -4.122e-03  3.156e-03   -1.306  0.19157
## Children      -3.760e-01  6.012e-04  -625.330 < 2e-16
## Age           3.997e-02  6.196e-05   645.016 < 2e-16
## Income         2.536e-08  4.610e-08    0.550  0.58225
## MaritalMarried -3.994e-03  4.106e-03   -0.973  0.33074
## MaritalNever Married -4.323e-04  4.050e-03   -0.107  0.91499
## MaritalSeparated 4.931e-04  4.021e-03    0.123  0.90241
## MaritalWidowed  -1.961e-03  4.008e-03   -0.489  0.62458
## GenderMale     -7.917e-01  2.620e-03  -302.139 < 2e-16
## GenderNonbinary 2.659e-01  8.691e-03   30.595 < 2e-16
## Churn1         1.785e-03  4.128e-03    0.432  0.66541
## Outage_sec_perweek 1.670e-04  4.330e-04    0.386  0.69969
## Email         -3.520e-04  4.265e-04   -0.825  0.40919
## Contacts       2.299e-04  1.296e-03    0.177  0.85921
## Yearly_equip_failure 4.083e-04  2.035e-03    0.201  0.84097
## Techie1       -1.266e-03  3.441e-03   -0.368  0.71296
## ContractOne year 3.730e-03  3.474e-03    1.074  0.28300
## ContractTwo Year 4.570e-03  3.294e-03    1.387  0.16534
## Port_modem1    -5.566e-04  2.585e-03   -0.215  0.82952
## Tablet1        2.625e-03  2.814e-03    0.933  0.35102
## InternetServiceFiber Optic 5.752e+00  4.262e-03  1349.615 < 2e-16
## InternetServiceNone 4.600e+00  4.061e-03  1132.949 < 2e-16
## Phone1        -3.347e-04  4.428e-03   -0.076  0.93975
## Multiple1      2.672e-01  5.462e-03   48.912 < 2e-16
## OnlineSecurity1 -8.315e-01  2.726e-03  -305.026 < 2e-16
## OnlineBackup1  -3.566e-01  4.215e-03  -84.606 < 2e-16
## DeviceProtection1 -5.956e-01  3.189e-03  -186.737 < 2e-16
## TechSupport1    3.827e-01  3.280e-03  116.681 < 2e-16
## StreamingTV1    -1.303e+00  6.703e-03  -194.425 < 2e-16
## StreamingMovies1 -7.270e-01  8.119e-03  -89.536 < 2e-16
## PaperlessBilling1 -5.597e-03  2.622e-03   -2.135  0.03281
## PaymentMethodCredit Card (automatic) 3.892e-03  3.935e-03    0.989  0.32275
## PaymentMethodElectronic Check 5.075e-03  3.522e-03    1.441  0.14967
## PaymentMethodMailed Check 1.171e-02  3.847e-03    3.045  0.00234
## MonthlyCharge  -3.513e-02  1.486e-04  -236.363 < 2e-16
## Bandwidth_GB_Year 1.221e-02  7.199e-07 16953.219 < 2e-16
## Timely_response2 9.895e-03  9.963e-03    0.993  0.32066
## Timely_response3 1.445e-02  1.010e-02    1.431  0.15252
## Timely_response4 1.366e-02  1.050e-02    1.301  0.19321
```

## Timely_response5	1.611e-02	1.124e-02	1.433	0.15182
## Timely_response6	2.188e-02	1.485e-02	1.474	0.14056
## Timely_response7	4.769e-02	3.151e-02	1.513	0.13025
## Timely_fixes2	-7.977e-03	1.046e-02	-0.762	0.44591
## Timely_fixes3	-8.362e-03	1.054e-02	-0.794	0.42751
## Timely_fixes4	-1.041e-02	1.081e-02	-0.963	0.33565
## Timely_fixes5	-8.773e-03	1.139e-02	-0.770	0.44126
## Timely_fixes6	-9.267e-03	1.454e-02	-0.637	0.52405
## Timely_fixes7	-4.466e-03	3.843e-02	-0.116	0.90750
## Timely_replacements2	1.336e-03	9.985e-03	0.134	0.89360
## Timely_replacements3	-3.354e-05	9.893e-03	-0.003	0.99729
## Timely_replacements4	-8.901e-04	1.009e-02	-0.088	0.92970
## Timely_replacements5	-1.341e-03	1.067e-02	-0.126	0.90004
## Timely_replacements6	1.615e-02	1.400e-02	1.154	0.24856
## Timely_replacements7	-1.270e-02	4.019e-02	-0.316	0.75201
## Timely_replacements8	-1.265e-01	1.173e-01	-1.078	0.28095
## Reliability2	5.398e-03	9.471e-03	0.570	0.56871
## Reliability3	8.658e-03	9.171e-03	0.944	0.34514
## Reliability4	8.070e-03	9.280e-03	0.870	0.38455
## Reliability5	1.014e-02	9.807e-03	1.034	0.30129
## Reliability6	1.247e-02	1.291e-02	0.966	0.33414
## Reliability7	-5.801e-02	4.926e-02	-1.178	0.23895
## Options2	-5.206e-03	1.001e-02	-0.520	0.60313
## Options3	-1.358e-04	9.795e-03	-0.014	0.98894
## Options4	-2.938e-03	9.917e-03	-0.296	0.76702
## Options5	-6.652e-03	1.049e-02	-0.634	0.52604
## Options6	-5.246e-04	1.347e-02	-0.039	0.96895
## Options7	-1.273e-02	4.212e-02	-0.302	0.76256
## Respectful2	1.785e-02	1.038e-02	1.720	0.08549
## Respectful3	1.147e-02	1.024e-02	1.121	0.26250
## Respectful4	7.977e-03	1.043e-02	0.765	0.44448
## Respectful5	1.212e-02	1.096e-02	1.106	0.26870
## Respectful6	1.680e-02	1.396e-02	1.203	0.22891
## Respectful7	2.612e-02	4.600e-02	0.568	0.57020
## Courteous2	-4.706e-05	9.430e-03	-0.005	0.99602
## Courteous3	-4.863e-03	9.125e-03	-0.533	0.59411
## Courteous4	-6.409e-03	9.235e-03	-0.694	0.48775
## Courteous5	-2.742e-03	9.775e-03	-0.281	0.77909
## Courteous6	-4.428e-03	1.283e-02	-0.345	0.73006
## Courteous7	-3.093e-02	3.743e-02	-0.826	0.40869
## Active_listening2	-2.888e-02	9.648e-03	-2.993	0.00277
## Active_listening3	-2.234e-02	9.309e-03	-2.400	0.01643
## Active_listening4	-2.334e-02	9.385e-03	-2.487	0.01292
## Active_listening5	-2.514e-02	9.869e-03	-2.548	0.01087
## Active_listening6	-1.507e-02	1.304e-02	-1.155	0.24795
## Active_listening7	2.600e-03	3.412e-02	0.076	0.93926
## Active_listening8	-1.562e-01	1.097e-01	-1.424	0.15455
##				
## (Intercept)	***			
## Population				
## AreaSuburban	**			
## AreaUrban				



```
## Children ***
## Age ***
## Income
## MaritalMarried
## MaritalNever Married
## MaritalSeparated
## MaritalWidowed
## GenderMale ***
## GenderNonbinary ***
## Churn1
## Outage_sec_perweek
## Email
## Contacts
## Yearly_equip_failure
## Techie1
## ContractOne year
## ContractTwo Year
## Port_modem1
## Tablet1
## InternetServiceFiber Optic ***
## InternetServiceNone ***
## Phone1
## Multiple1 ***
## OnlineSecurity1 ***
## OnlineBackup1 ***
## DeviceProtection1 ***
## TechSupport1 ***
## StreamingTV1 ***
## StreamingMovies1 ***
## PaperlessBilling1 *
## PaymentMethodCredit Card (automatic)
## PaymentMethodElectronic Check
## PaymentMethodMailed Check **
## MonthlyCharge ***
## Bandwidth_GB_Year ***
## Timely_response2
## Timely_response3
## Timely_response4
## Timely_response5
## Timely_response6
## Timely_response7
## Timely_fixes2
## Timely_fixes3
## Timely_fixes4
## Timely_fixes5
## Timely_fixes6
## Timely_fixes7
## Timely_replacements2
## Timely_replacements3
## Timely_replacements4
## Timely_replacements5
## Timely_replacements6
```

```

## Timely_replacements7
## Timely_replacements8
## Reliability2
## Reliability3
## Reliability4
## Reliability5
## Reliability6
## Reliability7
## Options2
## Options3
## Options4
## Options5
## Options6
## Options7
## Respectful2
## Respectful3
## Respectful4
## Respectful5
## Respectful6
## Respectful7
## Courteous2
## Courteous3
## Courteous4
## Courteous5
## Courteous6
## Courteous7
## Active_listening2
## Active_listening3
## Active_listening4
## Active_listening5
## Active_listening6
## Active_listening7
## Active_listening8
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1075 on 6911 degrees of freedom
## Multiple R-squared:  1, Adjusted R-squared:  1
## F-statistic: 4.799e+06 on 88 and 6911 DF, p-value: < 2.2e-16

```

**D2.** After running the initial linear model from the training set (“Initial\_model”) it became apparent that there were several values that were not statistically significant as noted by the lack of the **\*\*\*** marking that indicates that the values are statistically significant. I’ve chosen to use backward stepwise selection (**Larose & Larose, 2019**), and created a model named “stepwise\_model”, because I have a large amount of variables and backward elimination will remove each insignificant variable until only those values that have a meaningful contribution will remain.

The following table shows that this dimension reduction technique successfully decreased the amount of variables that would be included in the final model. However, “PaymentMethodElectronic Check”, “PaymentMethodCredit Card (automatic)”, and “AreaUrban” all have p-values that are greater than 0.05 indicating that these are not contributing significantly to the model. So, I looked at the Variance Inflation Factor (VIF) values of the stepwise model to check multicollinearity.

```
summary(Initial_model)
```

```
##
## Call:
## lm(formula = Tenure ~ Area + Children + Age + Gender + InternetService +
##      Multiple + OnlineSecurity + OnlineBackup + DeviceProtection +
##      TechSupport + StreamingTV + StreamingMovies + PaperlessBilling +
##      PaymentMethod + MonthlyCharge + Bandwidth_GB_Year, data = training_set)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.13667 -0.10827  0.08645  0.10502  0.13507
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -3.841e+00  1.390e-02  -276.328 < 2e-16
## AreaSuburban    -9.128e-03  3.150e-03   -2.898  0.00377
## AreaUrban       -4.160e-03  3.137e-03   -1.326  0.18491
## Children        -3.759e-01  5.974e-04  -629.244 < 2e-16
## Age              3.996e-02  6.160e-05   648.726 < 2e-16
## GenderMale      -7.921e-01  2.600e-03  -304.618 < 2e-16
## GenderNonbinary  2.646e-01  8.636e-03   30.635 < 2e-16
## InternetServiceFiber Optic  5.752e+00  4.124e-03  1394.903 < 2e-16
## InternetServiceNone  4.600e+00  4.021e-03  1144.221 < 2e-16
## Multiple1        2.679e-01  5.417e-03   49.451 < 2e-16
## OnlineSecurity1  -8.314e-01  2.709e-03  -306.867 < 2e-16
## OnlineBackup1    -3.564e-01  4.178e-03   -85.302 < 2e-16
## DeviceProtection1 -5.953e-01  3.170e-03  -187.808 < 2e-16
## TechSupport1      3.830e-01  3.247e-03   117.938 < 2e-16
## StreamingTV1     -1.302e+00  6.659e-03  -195.546 < 2e-16
## StreamingMovies1 -7.261e-01  8.067e-03   -90.003 < 2e-16
## PaperlessBilling1 -5.113e-03  2.604e-03   -1.963  0.04964
## PaymentMethodCredit Card (automatic)  3.828e-03  3.910e-03    0.979  0.32763
## PaymentMethodElectronic Check  5.123e-03  3.496e-03    1.466  0.14282
## PaymentMethodMailed Check  1.138e-02  3.820e-03    2.979  0.00290
## MonthlyCharge    -3.514e-02  1.460e-04  -240.680 < 2e-16
## Bandwidth_GB_Year  1.220e-02  5.940e-07  20546.755 < 2e-16
##
## (Intercept)      ***
## AreaSuburban      **
## AreaUrban
## Children          ***
## Age               ***
## GenderMale        ***
## GenderNonbinary   ***
## InternetServiceFiber Optic ***
## InternetServiceNone ***
## Multiple1         ***
## OnlineSecurity1    ***
## OnlineBackup1      ***
## DeviceProtection1  ***
## TechSupport1       ***
## StreamingTV1       ***
## StreamingMovies1   ***
```

```
## PaperlessBilling1          *
## PaymentMethodCredit Card (automatic)
## PaymentMethodElectronic Check
## PaymentMethodMailed Check    **
## MonthlyCharge              ***
## Bandwidth_GB_Year          ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1073 on 6978 degrees of freedom
## Multiple R-squared:      1, Adjusted R-squared:      1
## F-statistic: 2.017e+07 on 21 and 6978 DF, p-value: < 2.2e-16
```

According to Zach Bobbitt from statology, “A value greater than 5 indicates potentially severe correlation between a given predictor variable and other predictor variables in the model. In this case, the coefficient estimates and p-values in the regression output are likely unreliable. (**Z. Bobbitt, 2019**).” So, I looked for all VIF values above 5.

```
vif_values <- vif(Initial_model)
vif_values #Looking for VIF values above 5.
```

##		GVIF	Df	GVIF^(1/(2*Df))
##	Area	1.004114	2	1.001027
##	Children	1.002341	1	1.001170
##	Age	1.003046	1	1.001522
##	Gender	1.006402	2	1.001597
##	InternetService	3.285748	2	1.346352
##	Multiple	4.427459	1	2.104153
##	OnlineSecurity	1.025144	1	1.012494
##	OnlineBackup	2.623569	1	1.619743
##	DeviceProtection	1.503409	1	1.226136
##	TechSupport	1.492439	1	1.221654
##	StreamingTV	6.737752	1	2.595718
##	StreamingMovies	9.882268	1	3.143607
##	PaperlessBilling	1.002978	1	1.001488
##	PaymentMethod	1.005897	3	1.000980
##	MonthlyCharge	23.873153	1	4.886016
##	Bandwidth_GB_Year	1.022208	1	1.011043

As you can see, StreamingTV, StreamingMovies, and MonthlyCharge all had VIF values above 5. Because MonthlyCharge was so much higher than the rest, I decided to remove it first and see if that made the others acceptable.

```
vif_values <- vif(Initial_model)
vif_values #Looking for VIF values above 5.
```

##		GVIF	Df	GVIF^(1/(2*Df))
## Area	1.004114	2		1.001027
## Children	1.002341	1		1.001170
## Age	1.003046	1		1.001522
## Gender	1.006402	2		1.001597
## InternetService	3.285748	2		1.346352
## Multiple	4.427459	1		2.104153
## OnlineSecurity	1.025144	1		1.012494
## OnlineBackup	2.623569	1		1.619743
## DeviceProtection	1.503409	1		1.226136
## TechSupport	1.492439	1		1.221654
## StreamingTV	6.737752	1		2.595718
## StreamingMovies	9.882268	1		3.143607
## PaperlessBilling	1.002978	1		1.001488
## PaymentMethod	1.005897	3		1.000980
## MonthlyCharge	23.873153	1		4.886016
## Bandwidth_GB_Year	1.022208	1		1.011043

*# Removed MonthlyCharge since it was such a high VIF and then i will check VIF again to see if the others are ok*

```
reduced_model <- lm(formula = Tenure ~ Area + Children + Age + Gender + InternetService + Multiple + OnlineSecurity + OnlineBackup + DeviceProtection + TechSupport + StreamingTV + StreamingMovies + PaperlessBilling + PaymentMethod + Bandwidth_GB_Year, data = churn)
```

```
summary(reduced_model)
```

```
##
## Call:
## lm(formula = Tenure ~ Area + Children + Age + Gender + InternetService +
##      Multiple + OnlineSecurity + OnlineBackup + DeviceProtection +
##      TechSupport + StreamingTV + StreamingMovies + PaperlessBilling +
##      PaymentMethod + Bandwidth_GB_Year, data = churn)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.4652 -0.2355  0.1757  0.3843  0.4479
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      -6.783e+00   1.685e-02  -402.603   <2e-16
## AreaSuburban      -9.006e-03   8.028e-03   -1.122    0.262
## AreaUrban         -3.601e-03   8.042e-03   -0.448    0.654
## Children          -3.759e-01   1.528e-03  -245.924   <2e-16
## Age               3.987e-02   1.586e-04   251.398   <2e-16
## GenderMale        -7.834e-01   6.642e-03  -117.958   <2e-16
## GenderNonbinary    2.913e-01   2.208e-02   13.194   <2e-16
## InternetServiceFiber Optic  5.055e+00   7.483e-03  675.584   <2e-16
## InternetServiceNone  5.054e+00   9.063e-03  557.615   <2e-16
## Multiple1         -8.790e-01   6.580e-03  -133.576   <2e-16
## OnlineSecurity1    -9.253e-01   6.846e-03  -135.168   <2e-16
## OnlineBackup1     -1.150e+00   6.599e-03  -174.196   <2e-16
## DeviceProtection1 -1.038e+00   6.612e-03  -156.950   <2e-16
## TechSupport1      -5.701e-02   6.777e-03   -8.411   <2e-16
## StreamingTV1      -2.783e+00   6.569e-03  -423.675   <2e-16
## StreamingMovies1  -2.564e+00   6.568e-03  -390.369   <2e-16
## PaperlessBilling1 -9.508e-03   6.664e-03   -1.427    0.154
## PaymentMethodCredit Card (automatic)  1.069e-02   9.997e-03    1.070    0.285
## PaymentMethodElectronic Check  5.365e-03   8.940e-03    0.600    0.548
## PaymentMethodMailed Check  7.493e-03   9.761e-03    0.768    0.443
## Bandwidth_GB_Year  1.220e-02   1.515e-06  8055.715   <2e-16
##
## (Intercept)      ***
## AreaSuburban
## AreaUrban
## Children          ***
## Age               ***
## GenderMale        ***
## GenderNonbinary   ***
## InternetServiceFiber Optic  ***
## InternetServiceNone  ***
## Multiple1         ***
## OnlineSecurity1    ***
## OnlineBackup1     ***
## DeviceProtection1 ***
## TechSupport1      ***
## StreamingTV1      ***
## StreamingMovies1   ***
## PaperlessBilling1
```

```
## PaymentMethodCredit Card (automatic)
## PaymentMethodElectronic Check
## PaymentMethodMailed Check
## Bandwidth_GB_Year ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3278 on 9979 degrees of freedom
## Multiple R-squared:  0.9998, Adjusted R-squared:  0.9998
## F-statistic: 3.254e+06 on 20 and 9979 DF,  p-value: < 2.2e-16
```

I found that after removing MonthlyCharge with a VIF of 23.87, the model returned “AreaSuburban”, “AreaUrban”, “PaperlessBilling1,” “PaymentMethodCredit Card (automatic),” “PaymentMethodElectronic Check,” “PaymentMethodMailed Check” to all have values that were not statistically significant. The following table is the result of the second stepwise elimination. I checked the VIF values for the updated model and found all values around 1.

```
summary(reduced_model)
```



```
##
## Call:
## lm(formula = Tenure ~ Children + Age + Gender + InternetService +
##      Multiple + OnlineSecurity + OnlineBackup + DeviceProtection +
##      TechSupport + StreamingTV + StreamingMovies + Bandwidth_GB_Year,
##      data = churn)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.4536 -0.2314  0.1829  0.3839  0.4400
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -6.787e+00  1.443e-02 -470.301  <2e-16 ***
## Children        -3.759e-01  1.528e-03 -245.959  <2e-16 ***
## Age              3.987e-02  1.585e-04  251.483  <2e-16 ***
## GenderMale      -7.833e-01  6.638e-03 -117.996  <2e-16 ***
## GenderNonbinary  2.913e-01  2.207e-02   13.197  <2e-16 ***
## InternetServiceFiber Optic  5.055e+00  7.479e-03  675.955  <2e-16 ***
## InternetServiceNone  5.054e+00  9.061e-03  557.742  <2e-16 ***
## Multiple1       -8.790e-01  6.579e-03 -133.614  <2e-16 ***
## OnlineSecurity1  -9.253e-01  6.844e-03 -135.205  <2e-16 ***
## OnlineBackup1    -1.150e+00  6.597e-03 -174.256  <2e-16 ***
## DeviceProtection1 -1.038e+00  6.610e-03 -157.026  <2e-16 ***
## TechSupport1     -5.700e-02  6.775e-03   -8.412  <2e-16 ***
## StreamingTV1     -2.783e+00  6.567e-03 -423.764  <2e-16 ***
## StreamingMovies1 -2.564e+00  6.567e-03 -390.448  <2e-16 ***
## Bandwidth_GB_Year  1.220e-02  1.514e-06  8058.672  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3277 on 9985 degrees of freedom
## Multiple R-squared:  0.9998, Adjusted R-squared:  0.9998
## F-statistic: 4.649e+06 on 14 and 9985 DF, p-value: < 2.2e-16
```

**D3.** The updated model (reduced\_model), includes Tenure (dependant variable), Children, Age, GenderMale, GenderNonbinary, InternetServiceFiber Optic, InternetServiceNone, Multiple1, OnlineSecurity1, OnlineBackup1, DeviceProtection1, TechSupport1, StreamingTV1, StreamingMovies1, and Bandwidth\_GB\_Year.

The reduced\_model shows an adjusted R-squared value of 0.9998, meaning that the model accounts for 99.98% of variance in Tenure. The models f-statistic is 4.649e+06 and the p-value is 2.2e-16 which indicates that the model works and is highly significant. The Residuals range from -0.4536 to 0.4400 with a median of 0.1829. In this new model, all of the preidictor variabels are statistically significant.

**E1.** To compare the initial model and the reduced model, I used a kruskal-wallis test as opposed to an ANOVA becuase ANOVA assumes a normal distribution. Because the residuals are not normally distributed I used a non-parametric alternative to the ANOVA, known as the Kruskal-wallis test.

```
# comparing the residuals of each model.
kruskal.test(Residuals ~ Model, data = residuals_df)
```

```
##  
## Kruskal-Wallis rank sum test  
##  
## data: Residuals by Model  
## Kruskal-Wallis chi-squared = 1.2851, df = 1, p-value = 0.2569
```

The Kruskal-Wallis test compares the distributions of residuals between two models and tests whether their medians are the same. The test statistic (chi-squared = 1.2851) with 1 degree of freedom returned a p-value of 0.2569, indicating no significant difference between the residual distributions of the models. This suggests that the residuals from both models are similar in distribution. Because the p-value is greater than 0.05, I fail to reject the null hypothesis that there is no difference between the distribution of the residuals in each model.

To compare the statistics of the two models, I have included their key metrics below.

The initial model shows a residual standard error (RSE) of 0.1075, while the reduced model has an RSE of 0.3277. As expected, this indicates that the initial model fits the data more closely than the reduced model. The initial model included 88 predictors (residual degrees of freedom), compared to only 14 predictors in the reduced model. Despite this difference, the reduced model still captured 99.98% of the variability in the dependent variable (R-squared = 0.9998) with far fewer predictors, making it less complex, which is good for keeping down data collection costs if each variable has data that needs to be collected. In contrast, the initial model captured 100% of the variability (R-squared = 1) but with significantly more predictors.

Both models have similarly large F-statistics, 4.799e+06 for the initial model and 4.649e+06 for the reduced model, along with statistically significant p-values. This demonstrates that both models are highly effective at explaining variance in the dependent variable and are statistically significant.

## Initial model statistics:

```
##
## Call:
## lm(formula = Tenure ~ ., data = training_set)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.15449 -0.10738  0.07453  0.10508  0.16148
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -3.836e+00  2.854e-02  -134.392 < 2e-16
## Population    -2.747e-09  8.908e-08   -0.031  0.97540
## AreaSuburban  -9.197e-03  3.169e-03   -2.903  0.00371
## AreaUrban     -4.122e-03  3.156e-03   -1.306  0.19157
## Children     -3.760e-01  6.012e-04  -625.330 < 2e-16
## Age           3.997e-02  6.196e-05   645.016 < 2e-16
## Income        2.536e-08  4.610e-08    0.550  0.58225
## MaritalMarried -3.994e-03  4.106e-03   -0.973  0.33074
## MaritalNever Married -4.323e-04  4.050e-03   -0.107  0.91499
## MaritalSeparated 4.931e-04  4.021e-03    0.123  0.90241
## MaritalWidowed  -1.961e-03  4.008e-03   -0.489  0.62458
## GenderMale     -7.917e-01  2.620e-03  -302.139 < 2e-16
## GenderNonbinary 2.659e-01  8.691e-03   30.595 < 2e-16
## Churn1         1.785e-03  4.128e-03    0.432  0.66541
## Outage_sec_perweek 1.670e-04  4.330e-04    0.386  0.69969
## Email         -3.520e-04  4.265e-04   -0.825  0.40919
## Contacts       2.299e-04  1.296e-03    0.177  0.85921
## Yearly_equip_failure 4.083e-04  2.035e-03    0.201  0.84097
## Techie1       -1.266e-03  3.441e-03   -0.368  0.71296
## ContractOne year 3.730e-03  3.474e-03    1.074  0.28300
## ContractTwo Year 4.570e-03  3.294e-03    1.387  0.16534
## Port_modem1   -5.566e-04  2.585e-03   -0.215  0.82952
## Tablet1       2.625e-03  2.814e-03    0.933  0.35102
## InternetServiceFiber Optic 5.752e+00  4.262e-03  1349.615 < 2e-16
## InternetServiceNone 4.600e+00  4.061e-03  1132.949 < 2e-16
## Phone1       -3.347e-04  4.428e-03   -0.076  0.93975
## Multiple1     2.672e-01  5.462e-03   48.912 < 2e-16
## OnlineSecurity1 -8.315e-01  2.726e-03  -305.026 < 2e-16
## OnlineBackup1  -3.566e-01  4.215e-03  -84.606 < 2e-16
## DeviceProtection1 -5.956e-01  3.189e-03  -186.737 < 2e-16
## TechSupport1   3.827e-01  3.280e-03   116.681 < 2e-16
## StreamingTV1   -1.303e+00  6.703e-03  -194.425 < 2e-16
## StreamingMovies1 -7.270e-01  8.119e-03  -89.536 < 2e-16
## PaperlessBilling1 -5.597e-03  2.622e-03   -2.135  0.03281
## PaymentMethodCredit Card (automatic) 3.892e-03  3.935e-03    0.989  0.32275
## PaymentMethodElectronic Check 5.075e-03  3.522e-03    1.441  0.14967
## PaymentMethodMailed Check 1.171e-02  3.847e-03    3.045  0.00234
## MonthlyCharge  -3.513e-02  1.486e-04  -236.363 < 2e-16
## Bandwidth_GB_Year 1.221e-02  7.199e-07  16953.219 < 2e-16
## Timely_response2 9.895e-03  9.963e-03    0.993  0.32066
```

## Timely_response3	1.445e-02	1.010e-02	1.431	0.15252
## Timely_response4	1.366e-02	1.050e-02	1.301	0.19321
## Timely_response5	1.611e-02	1.124e-02	1.433	0.15182
## Timely_response6	2.188e-02	1.485e-02	1.474	0.14056
## Timely_response7	4.769e-02	3.151e-02	1.513	0.13025
## Timely_fixes2	-7.977e-03	1.046e-02	-0.762	0.44591
## Timely_fixes3	-8.362e-03	1.054e-02	-0.794	0.42751
## Timely_fixes4	-1.041e-02	1.081e-02	-0.963	0.33565
## Timely_fixes5	-8.773e-03	1.139e-02	-0.770	0.44126
## Timely_fixes6	-9.267e-03	1.454e-02	-0.637	0.52405
## Timely_fixes7	-4.466e-03	3.843e-02	-0.116	0.90750
## Timely_replacements2	1.336e-03	9.985e-03	0.134	0.89360
## Timely_replacements3	-3.354e-05	9.893e-03	-0.003	0.99729
## Timely_replacements4	-8.901e-04	1.009e-02	-0.088	0.92970
## Timely_replacements5	-1.341e-03	1.067e-02	-0.126	0.90004
## Timely_replacements6	1.615e-02	1.400e-02	1.154	0.24856
## Timely_replacements7	-1.270e-02	4.019e-02	-0.316	0.75201
## Timely_replacements8	-1.265e-01	1.173e-01	-1.078	0.28095
## Reliability2	5.398e-03	9.471e-03	0.570	0.56871
## Reliability3	8.658e-03	9.171e-03	0.944	0.34514
## Reliability4	8.070e-03	9.280e-03	0.870	0.38455
## Reliability5	1.014e-02	9.807e-03	1.034	0.30129
## Reliability6	1.247e-02	1.291e-02	0.966	0.33414
## Reliability7	-5.801e-02	4.926e-02	-1.178	0.23895
## Options2	-5.206e-03	1.001e-02	-0.520	0.60313
## Options3	-1.358e-04	9.795e-03	-0.014	0.98894
## Options4	-2.938e-03	9.917e-03	-0.296	0.76702
## Options5	-6.652e-03	1.049e-02	-0.634	0.52604
## Options6	-5.246e-04	1.347e-02	-0.039	0.96895
## Options7	-1.273e-02	4.212e-02	-0.302	0.76256
## Respectful2	1.785e-02	1.038e-02	1.720	0.08549
## Respectful3	1.147e-02	1.024e-02	1.121	0.26250
## Respectful4	7.977e-03	1.043e-02	0.765	0.44448
## Respectful5	1.212e-02	1.096e-02	1.106	0.26870
## Respectful6	1.680e-02	1.396e-02	1.203	0.22891
## Respectful7	2.612e-02	4.600e-02	0.568	0.57020
## Courteous2	-4.706e-05	9.430e-03	-0.005	0.99602
## Courteous3	-4.863e-03	9.125e-03	-0.533	0.59411
## Courteous4	-6.409e-03	9.235e-03	-0.694	0.48775
## Courteous5	-2.742e-03	9.775e-03	-0.281	0.77909
## Courteous6	-4.428e-03	1.283e-02	-0.345	0.73006
## Courteous7	-3.093e-02	3.743e-02	-0.826	0.40869
## Active_listening2	-2.888e-02	9.648e-03	-2.993	0.00277
## Active_listening3	-2.234e-02	9.309e-03	-2.400	0.01643
## Active_listening4	-2.334e-02	9.385e-03	-2.487	0.01292
## Active_listening5	-2.514e-02	9.869e-03	-2.548	0.01087
## Active_listening6	-1.507e-02	1.304e-02	-1.155	0.24795
## Active_listening7	2.600e-03	3.412e-02	0.076	0.93926
## Active_listening8	-1.562e-01	1.097e-01	-1.424	0.15455
##				
## (Intercept)	***			
## Population				

```
## AreaSuburban          **
## AreaUrban
## Children              ***
## Age                   ***
## Income
## MaritalMarried
## MaritalNever Married
## MaritalSeparated
## MaritalWidowed
## GenderMale            ***
## GenderNonbinary       ***
## Churn1
## Outage_sec_perweek
## Email
## Contacts
## Yearly_equip_failure
## Techie1
## ContractOne year
## ContractTwo Year
## Port_modem1
## Tablet1
## InternetServiceFiber Optic ***
## InternetServiceNone    ***
## Phone1
## Multiple1              ***
## OnlineSecurity1        ***
## OnlineBackup1          ***
## DeviceProtection1      ***
## TechSupport1           ***
## StreamingTV1           ***
## StreamingMovies1       ***
## PaperlessBilling1      *
## PaymentMethodCredit Card (automatic)
## PaymentMethodElectronic Check
## PaymentMethodMailed Check **
## MonthlyCharge          ***
## Bandwidth_GB_Year      ***
## Timely_response2
## Timely_response3
## Timely_response4
## Timely_response5
## Timely_response6
## Timely_response7
## Timely_fixes2
## Timely_fixes3
## Timely_fixes4
## Timely_fixes5
## Timely_fixes6
## Timely_fixes7
## Timely_replacements2
## Timely_replacements3
## Timely_replacements4
```

```

## Timely_replacements5
## Timely_replacements6
## Timely_replacements7
## Timely_replacements8
## Reliability2
## Reliability3
## Reliability4
## Reliability5
## Reliability6
## Reliability7
## Options2
## Options3
## Options4
## Options5
## Options6
## Options7
## Respectful2          .
## Respectful3
## Respectful4
## Respectful5
## Respectful6
## Respectful7
## Courteous2
## Courteous3
## Courteous4
## Courteous5
## Courteous6
## Courteous7
## Active_listening2    **
## Active_listening3    *
## Active_listening4    *
## Active_listening5    *
## Active_listening6
## Active_listening7
## Active_listening8
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1075 on 6911 degrees of freedom
## Multiple R-squared:  1, Adjusted R-squared:  1
## F-statistic: 4.799e+06 on 88 and 6911 DF, p-value: < 2.2e-16

```

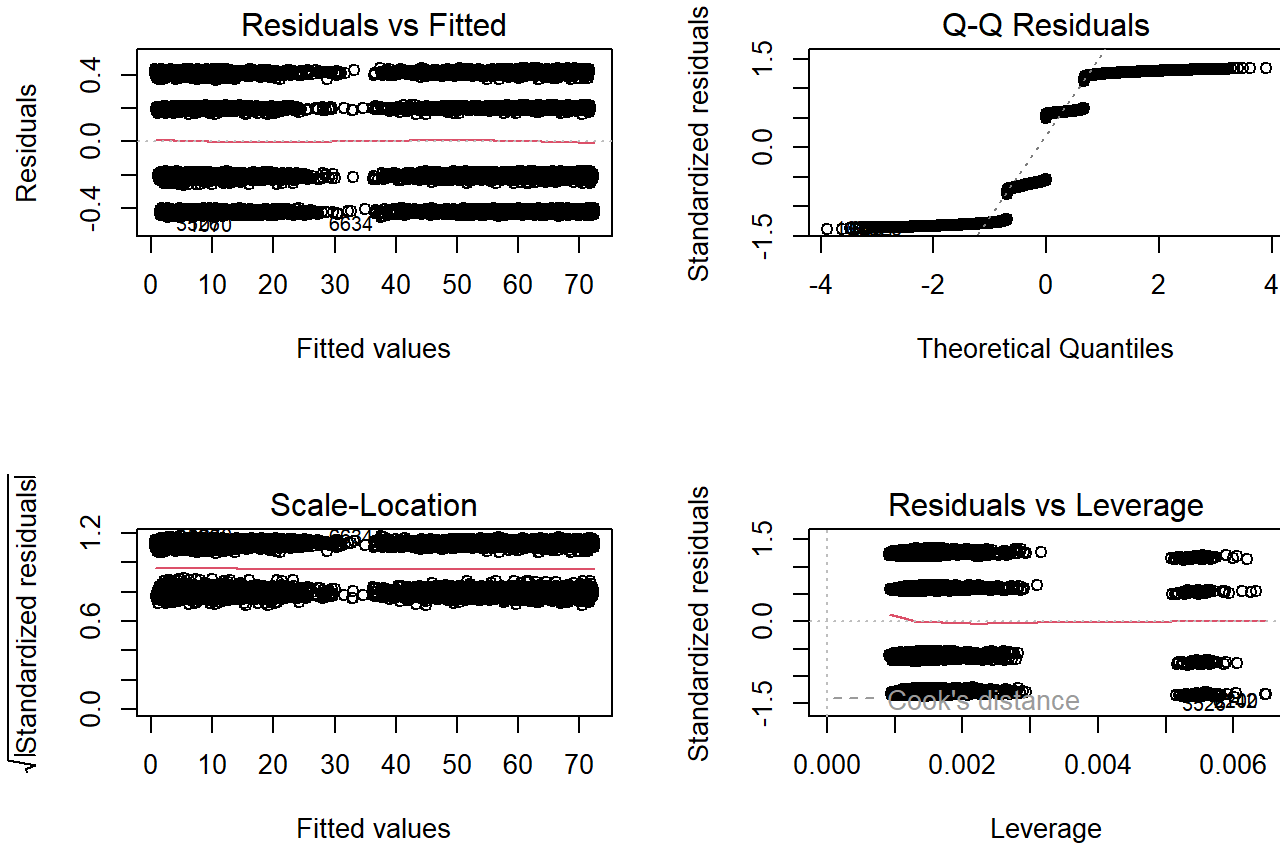
## Reduced model statistics:

```
##
## Call:
## lm(formula = Tenure ~ Children + Age + Gender + InternetService +
##      Multiple + OnlineSecurity + OnlineBackup + DeviceProtection +
##      TechSupport + StreamingTV + StreamingMovies + Bandwidth_GB_Year,
##      data = churn)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.4536 -0.2314  0.1829  0.3839  0.4400
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -6.787e+00  1.443e-02 -470.301  <2e-16 ***
## Children       -3.759e-01  1.528e-03 -245.959  <2e-16 ***
## Age            3.987e-02  1.585e-04  251.483  <2e-16 ***
## GenderMale     -7.833e-01  6.638e-03 -117.996  <2e-16 ***
## GenderNonbinary 2.913e-01  2.207e-02  13.197  <2e-16 ***
## InternetServiceFiber Optic 5.055e+00  7.479e-03  675.955  <2e-16 ***
## InternetServiceNone 5.054e+00  9.061e-03  557.742  <2e-16 ***
## Multiple1      -8.790e-01  6.579e-03 -133.614  <2e-16 ***
## OnlineSecurity1 -9.253e-01  6.844e-03 -135.205  <2e-16 ***
## OnlineBackup1  -1.150e+00  6.597e-03 -174.256  <2e-16 ***
## DeviceProtection1 -1.038e+00  6.610e-03 -157.026  <2e-16 ***
## TechSupport1    -5.700e-02  6.775e-03  -8.412  <2e-16 ***
## StreamingTV1    -2.783e+00  6.567e-03 -423.764  <2e-16 ***
## StreamingMovies1 -2.564e+00  6.567e-03 -390.448  <2e-16 ***
## Bandwidth_GB_Year 1.220e-02  1.514e-06 8058.672  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3277 on 9985 degrees of freedom
## Multiple R-squared:  0.9998, Adjusted R-squared:  0.9998
## F-statistic: 4.649e+06 on 14 and 9985 DF, p-value: < 2.2e-16
```

**E2.** I will include the full code file in my assessment uploads.

The reduced model has a residual standard error of 0.3277 and a adjusted r-squared value of 0.9998. This suggests that the model has very good fit. In terms of predictive power, this residual standard error indicates that the reduced model provides very precise predictions.

## Diagnostic Plots for Reduced Model



The **residuals vs leverage** (bottom right) plot shows that there are no high leverage point or outliers based on 'cooks distance.'

The **Q-Q residuals** plot (top right) show that the residuals do not stick to the diagonal line especially on the tails indicating that the residuals are not normally distributed.

The **residuals vs fitted** (top left) plot show that the horizontal red line is reasonably flat but the residuals show horizontal lines rather than randomness suggesting heteroscedasticity rather than the assumption of homoscedasticity.

The **scale-location** (bottom left) plot checks for homoscedasticity. Once again the residuals show horizontal lines. Ideally these values should be evenly spread across the plot.

## Predicted values:

```
#Getting the predicted values with the test data
y_pred = predict(reduced_model, newdata = test_set)

#print the predicted values
y_pred
```



##	1	2	3	4	5	6	7
##	1.5920497	16.6746050	1.2668099	4.4624421	19.0625900	14.0928134	12.4036666
##	8	9	10	11	12	13	14
##	20.2576384	8.1409243	4.5726253	11.3104666	3.7855797	20.4783207	2.8938447
##	15	16	17	18	19	20	21
##	11.7650353	5.2998844	6.3147384	15.9433238	9.2268934	4.9042582	11.0170793
##	22	23	24	25	26	27	28
##	11.8287920	24.3425223	8.1833143	14.7516292	5.0673079	4.1575074	4.2016903
##	29	30	31	32	33	34	35
##	6.9996851	17.0385798	3.4224259	11.1899686	4.8023441	18.3084940	12.7091992
##	36	37	38	39	40	41	42
##	13.0160143	7.6508764	2.3142117	9.9752344	6.1716167	6.8343880	15.0682160
##	43	44	45	46	47	48	49
##	3.0407019	6.5856768	5.1352186	8.3001811	19.2949693	9.8268343	2.5614105
##	50	51	52	53	54	55	56
##	16.0821323	17.6644708	5.7899817	6.5785460	2.7584021	3.4852652	18.3649931
##	57	58	59	60	61	62	63
##	18.1682503	15.5438054	21.4899074	4.7449966	5.4070193	10.7163566	5.4983582
##	64	65	66	67	68	69	70
##	12.4352799	8.9867782	16.1818868	23.3231030	13.1488651	12.2046999	2.0596187
##	71	72	73	74	75	76	77
##	1.6325478	6.9756238	10.7954202	3.1928066	9.8238160	1.5864408	2.7940059
##	78	79	80	81	82	83	84
##	9.9414856	9.3443248	20.7799171	5.6237288	12.2145187	8.5784727	15.0693862
##	85	86	87	88	89	90	91
##	8.0662927	4.2635016	14.3440748	2.8028377	9.6160105	12.2773574	2.2778217
##	92	93	94	95	96	97	98
##	4.4261286	3.3162147	5.5389104	23.2895403	11.5375977	2.0112681	13.8732297
##	99	100	101	102	103	104	105
##	6.9023869	13.5339498	14.9474569	8.5709364	14.8658097	2.4824642	9.9743771
##	106	107	108	109	110	111	112
##	10.0631987	21.9300059	2.1169874	7.4910014	5.6249076	10.7502683	17.8118574
##	113	114	115	116	117	118	119
##	17.7165916	2.8493214	6.1605640	5.5750237	1.8730862	8.8373783	0.9665976
##	120	121	122	123	124	125	126
##	32.7250048	10.6769507	6.6122844	7.6923488	16.7227234	13.6375289	2.1122739
##	127	128	129	130	131	132	133
##	0.9885613	17.2601832	10.6573015	16.9183634	5.4248745	11.0274705	14.2684542
##	134	135	136	137	138	139	140
##	9.8922042	7.5896790	14.2811296	8.6821577	5.1850063	7.3999187	1.4594036
##	141	142	143	144	145	146	147
##	1.8605076	1.8140223	15.7830989	9.0095678	17.1354727	1.3470654	1.7517060
##	148	149	150	151	152	153	154
##	5.3886216	6.8046771	7.0414606	15.2044801	2.1911474	2.0474882	8.4958380
##	155	156	157	158	159	160	161
##	6.3951395	9.6465500	1.6238238	7.5794689	7.4951718	2.0027224	15.1820180
##	162	163	164	165	166	167	168
##	22.3389471	10.8201045	4.6943138	1.4725992	5.3250831	13.9894636	19.6257901
##	169	170	171	172	173	174	175
##	6.3814239	3.8339571	1.2848290	6.8015802	2.5475350	14.3119371	12.0627922
##	176	177	178	179	180	181	182
##	15.6033974	3.2705930	14.9932675	1.0842242	3.9158178	2.2178065	2.7507337

##	183	184	185	186	187	188	189
##	3.2862600	5.3559455	2.5704314	11.6067246	1.2543213	5.7489922	15.1794478
##	190	191	192	193	194	195	196
##	4.9447277	19.4038473	14.7231443	2.8697286	24.6156616	5.1113990	3.8518661
##	197	198	199	200	201	202	203
##	13.8228678	6.7601456	20.9814077	10.1572765	2.2598822	7.4396483	1.4644657
##	204	205	206	207	208	209	210
##	5.7988854	16.4794272	19.6399563	14.6752572	9.9482744	7.5140750	8.6888153
##	211	212	213	214	215	216	217
##	17.4005168	8.0479528	11.0228456	10.0298226	5.5686869	5.9755753	9.2739724
##	218	219	220	221	222	223	224
##	5.0191616	9.9330768	14.9071468	9.4035700	8.6684186	11.2952872	7.8680940
##	225	226	227	228	229	230	231
##	5.8579634	5.0256452	5.6187274	2.7108741	4.7247834	3.5405328	21.9819550
##	232	233	234	235	236	237	238
##	3.6258339	2.5188704	8.8426238	4.4193317	8.4831365	10.1559420	3.3820948
##	239	240	241	242	243	244	245
##	11.3187040	6.9219715	4.5338321	13.9877116	9.5806589	28.7296098	20.1103087
##	246	247	248	249	250	251	252
##	4.8709259	1.5543976	5.4871839	8.2538061	1.6655886	4.1968676	15.5406495
##	253	254	255	256	257	258	259
##	20.1893888	17.5451899	10.4022986	26.4471270	4.5959943	4.6910707	7.2518191
##	260	261	262	263	264	265	266
##	1.8646419	2.5147442	15.1120626	13.5646477	18.2555606	4.8717141	5.0494316
##	267	268	269	270	271	272	273
##	9.4016830	10.1408620	10.5941625	3.0871071	1.2379077	11.1521086	15.6135997
##	274	275	276	277	278	279	280
##	3.3365241	8.7377086	7.5963686	10.0843953	15.0256135	12.6224900	4.8528822
##	281	282	283	284	285	286	287
##	14.2483004	3.1653007	4.9378096	4.6260065	12.0162962	5.3250432	15.4989488
##	288	289	290	291	292	293	294
##	5.4965626	27.6854742	9.9684961	18.3010861	2.1823039	8.6500569	2.4695273
##	295	296	297	298	299	300	301
##	1.9520485	6.9531675	1.9886332	9.9020055	19.2462191	15.7173255	4.7588206
##	302	303	304	305	306	307	308
##	16.6896231	8.7723481	6.1249003	3.5247968	18.8101356	18.5168894	3.8850855
##	309	310	311	312	313	314	315
##	0.9984146	1.8179159	9.9128376	18.2519382	8.2887032	7.6681815	10.6125450
##	316	317	318	319	320	321	322
##	4.3578906	4.3900400	9.4787272	2.0048810	11.6158955	2.1163106	16.2083787
##	323	324	325	326	327	328	329
##	8.2621630	18.9487442	5.4188773	6.5857873	6.9666622	17.2044912	2.0195984
##	330	331	332	333	334	335	336
##	8.6809035	6.8670357	14.9919650	7.3323028	1.9591009	11.2516988	4.0800306
##	337	338	339	340	341	342	343
##	8.2733304	9.9389470	2.9289811	10.0496568	18.8581732	9.1613390	2.3404578
##	344	345	346	347	348	349	350
##	3.4854047	17.8719879	14.4571164	6.6603461	7.6822316	3.6121932	8.9737557
##	351	352	353	354	355	356	357
##	6.5493676	17.3046740	6.3855345	18.9690151	2.3246109	6.8823819	1.5230914
##	358	359	360	361	362	363	364
##	2.1978949	1.6385992	9.2594442	5.6675317	19.7278702	5.9858191	7.4046927

##	365	366	367	368	369	370	371
##	6.5795296	23.7315409	4.9993251	18.0162011	4.2674643	20.6932058	8.6249834
##	372	373	374	375	376	377	378
##	8.9791445	3.3876384	9.7665647	15.3762087	8.4705423	5.4346841	22.5129196
##	379	380	381	382	383	384	385
##	27.5505330	10.3737918	17.7293433	16.3901097	0.8242306	3.8628827	9.9363195
##	386	387	388	389	390	391	392
##	6.5225858	3.8668418	10.8833943	7.4755034	11.8106597	25.6910103	16.0024931
##	393	394	395	396	397	398	399
##	0.9585376	10.8350187	4.4380314	5.5081562	2.6596962	2.7631846	8.7697378
##	400	401	402	403	404	405	406
##	7.6209227	2.7788438	4.4400679	10.0723268	20.5483016	7.8948728	14.2756259
##	407	408	409	410	411	412	413
##	5.0805113	1.2665061	12.7153454	7.6168317	3.9080682	2.7114830	17.2441956
##	414	415	416	417	418	419	420
##	1.3233563	2.7874573	9.6236505	3.2759287	4.3923505	5.8936034	5.4859872
##	421	422	423	424	425	426	427
##	4.2492742	11.8609003	10.4797715	3.6316792	2.0550140	16.0679877	7.5424187
##	428	429	430	431	432	433	434
##	5.2129496	9.2751362	6.1772557	2.4139470	18.6574114	6.4094368	9.1746545
##	435	436	437	438	439	440	441
##	4.1417450	8.4148652	1.9879498	4.4446895	0.8419483	13.0457574	10.8363643
##	442	443	444	445	446	447	448
##	1.7729496	12.2276496	4.2291566	4.2196647	19.9305155	8.0249632	2.9619002
##	449	450	451	452	453	454	455
##	7.9512416	10.9020836	12.8851930	2.3424356	14.8070471	29.4930712	2.2610659
##	456	457	458	459	460	461	462
##	18.2212524	16.6602226	2.1984049	17.8996955	6.7697869	2.4948412	1.9033598
##	463	464	465	466	467	468	469
##	15.2756552	11.3329430	10.9705359	8.2411208	1.4808641	10.8143061	19.7637029
##	470	471	472	473	474	475	476
##	8.6752045	9.4675497	2.0182402	4.1730788	9.1277161	2.9122984	16.4463003
##	477	478	479	480	481	482	483
##	5.5735490	8.5493909	7.1698930	5.9708607	2.9295151	3.7554688	4.1262334
##	484	485	486	487	488	489	490
##	4.0552870	21.4162270	8.8015457	3.5392175	4.9999834	4.6916241	11.8552939
##	491	492	493	494	495	496	497
##	11.2687239	25.9858834	12.6072839	14.9428301	4.6592852	12.7210785	3.8493500
##	498	499	500	501	502	503	504
##	18.8836284	9.7680782	10.6512055	6.7298243	11.2604245	11.3957214	6.9825565
##	505	506	507	508	509	510	511
##	13.5890924	6.3519285	11.2793041	0.8415173	6.5400357	7.8217997	8.9580075
##	512	513	514	515	516	517	518
##	6.0991671	2.4256094	13.8644608	7.6552339	9.6425416	16.1833931	16.3340502
##	519	520	521	522	523	524	525
##	7.9194181	8.9174322	3.0931450	7.7233661	6.0714066	9.0701362	2.0925752
##	526	527	528	529	530	531	532
##	8.8463531	4.3817725	14.5287827	17.5619608	8.0518556	13.7149145	5.9777225
##	533	534	535	536	537	538	539
##	15.3190726	7.0438593	3.7504864	13.6430469	8.2824764	8.1438895	3.5494429
##	540	541	542	543	544	545	546
##	0.6105294	16.6921584	15.3153002	2.2382948	4.2942197	7.7894143	2.9034439

##	547	548	549	550	551	552	553
##	2.1482621	16.5359357	7.9890701	9.0877475	2.7409085	9.5893039	13.1214307
##	554	555	556	557	558	559	560
##	12.7437403	1.0554267	7.0636298	6.0817484	4.7310585	7.0102420	12.8096129
##	561	562	563	564	565	566	567
##	17.8097246	17.8922309	11.8715537	0.9586230	7.6089860	1.1686455	13.6159969
##	568	569	570	571	572	573	574
##	20.6594954	6.3767757	14.6511818	3.5984958	7.4120723	7.0058861	18.1815547
##	575	576	577	578	579	580	581
##	2.6103252	7.5908483	18.3991872	4.1093878	7.0337686	3.9848218	1.3253940
##	582	583	584	585	586	587	588
##	15.3456490	4.8238214	12.7456801	22.5686577	11.4657368	12.6297013	1.6537855
##	589	590	591	592	593	594	595
##	4.6623595	1.2160703	14.4297337	3.2936375	3.6217614	10.5767897	14.2231181
##	596	597	598	599	600	601	602
##	16.4162461	5.5349255	21.4902812	5.5952351	6.4574933	8.9675988	17.8095643
##	603	604	605	606	607	608	609
##	3.5769393	11.2269896	7.2163771	6.7671719	4.3718786	10.2684144	6.0163101
##	610	611	612	613	614	615	616
##	8.7713144	3.2808042	2.4889574	25.3738913	19.0997288	2.2649755	2.4597769
##	617	618	619	620	621	622	623
##	30.9142102	21.2346445	13.2177476	9.9306420	2.2085964	12.4402301	5.6954491
##	624	625	626	627	628	629	630
##	7.6832170	26.6907845	14.6773581	12.9139538	10.2374463	30.6107289	5.4668173
##	631	632	633	634	635	636	637
##	10.6638555	18.1892405	6.5793747	11.9015033	5.5997852	19.9587758	11.1218703
##	638	639	640	641	642	643	644
##	14.7222891	28.0905594	17.2757860	8.4861232	11.0265238	7.9544118	9.8042740
##	645	646	647	648	649	650	651
##	7.9799421	4.8758536	6.4683371	4.9503018	2.9673847	12.5183696	10.3923567
##	652	653	654	655	656	657	658
##	0.8188160	4.8214318	16.7147920	9.3534577	7.1688740	4.2359021	2.1123123
##	659	660	661	662	663	664	665
##	10.2832191	17.3502347	7.4688998	4.0822176	3.1330393	1.7667564	2.4087839
##	666	667	668	669	670	671	672
##	10.9285764	3.8334503	27.1622007	11.5030404	13.5080004	10.1703390	9.3402771
##	673	674	675	676	677	678	679
##	10.7580776	14.0914115	5.3962790	2.6154266	8.0716631	5.6756215	2.5287121
##	680	681	682	683	684	685	686
##	11.8221063	4.8715597	27.3182484	3.1737784	12.4581849	3.6433554	25.5416728
##	687	688	689	690	691	692	693
##	10.7118005	16.5898777	6.3479185	7.9740299	24.2274169	7.1804962	8.2961031
##	694	695	696	697	698	699	700
##	7.6105934	5.1994264	12.5026916	2.3449398	13.3563654	12.6411297	15.1882734
##	701	702	703	704	705	706	707
##	1.7827528	7.6740580	3.8150792	10.0148796	3.0054556	1.5784466	2.0831829
##	708	709	710	711	712	713	714
##	20.2506632	2.3469866	1.2828762	11.5765730	14.5874252	11.2865949	7.0376432
##	715	716	717	718	719	720	721
##	5.4039150	19.9957261	9.3163306	13.8240292	14.5762905	1.8744449	5.9464847
##	722	723	724	725	726	727	728
##	10.6164446	15.2769282	4.4586087	4.1491689	13.4805355	19.3436221	4.1949529

##	729	730	731	732	733	734	735
##	16.2113410	10.7115599	12.9442674	20.1446592	1.2796679	7.7394177	6.2612728
##	736	737	738	739	740	741	742
##	1.2460451	2.0150555	5.8363853	3.1823460	5.6443363	26.3573437	7.6276620
##	743	744	745	746	747	748	749
##	19.7144020	20.4961560	9.4056289	16.1359655	5.2890922	6.5302654	1.5606841
##	750	751	752	753	754	755	756
##	17.2978510	16.4720969	3.8226113	23.9565183	17.4117723	27.0267199	9.4141129
##	757	758	759	760	761	762	763
##	12.3240394	4.0272464	19.1710169	16.3850900	18.9541029	0.9843440	0.6206789
##	764	765	766	767	768	769	770
##	14.8352215	2.8607903	7.6093777	29.2192365	4.2607708	2.7088221	1.9686506
##	771	772	773	774	775	776	777
##	6.9457351	10.0520772	9.4025701	3.9577420	17.9042781	1.3809362	21.9206334
##	778	779	780	781	782	783	784
##	3.5720877	11.4545770	9.0940960	9.4951232	28.0340382	8.0288597	1.3167556
##	785	786	787	788	789	790	791
##	2.5841189	1.6916008	6.5791678	7.2536270	30.4213426	7.4332017	2.0550748
##	792	793	794	795	796	797	798
##	15.9185400	9.6046144	0.9981899	1.8110443	17.1381878	3.0917505	6.1112786
##	799	800	801	802	803	804	805
##	5.0016028	7.1258984	11.2635399	17.0680993	11.9548483	6.8469711	5.2577151
##	806	807	808	809	810	811	812
##	4.3366079	22.5451260	4.3248959	8.8115058	1.5732963	10.9651199	14.8106151
##	813	814	815	816	817	818	819
##	1.7848683	1.5750243	10.8333115	8.6093641	4.6823868	25.2838481	2.7347913
##	820	821	822	823	824	825	826
##	8.7777942	2.2209402	2.5468462	10.4414867	3.8087254	11.5812518	13.6209951
##	827	828	829	830	831	832	833
##	15.0400314	15.9487759	3.8891217	11.8105513	7.0012949	10.0759881	5.4876164
##	834	835	836	837	838	839	840
##	4.1869169	18.7711062	23.7860508	7.9027063	13.9606646	19.1605979	3.0780658
##	841	842	843	844	845	846	847
##	4.5488914	6.6899923	20.1281447	12.3582727	2.4424706	3.9003289	4.0859682
##	848	849	850	851	852	853	854
##	11.5178670	5.4269245	18.3206024	8.9026860	13.4537602	5.0360750	12.9117983
##	855	856	857	858	859	860	861
##	5.0708237	3.4286267	10.5237135	14.1805638	5.8808233	7.3982316	4.5503461
##	862	863	864	865	866	867	868
##	20.6788261	4.0630834	27.2537799	15.7683380	8.4443750	4.8851159	4.6359471
##	869	870	871	872	873	874	875
##	1.3482391	3.8903154	8.7978682	5.1991358	13.7587890	16.9976236	17.1321059
##	876	877	878	879	880	881	882
##	11.1225898	5.0655764	22.6681934	19.8317753	13.0852185	14.5762015	4.8474739
##	883	884	885	886	887	888	889
##	6.9228552	11.0646931	21.0664080	5.8581710	6.0333228	16.0233724	5.7757808
##	890	891	892	893	894	895	896
##	10.9145905	4.5782399	12.4041674	21.2636652	2.9106165	2.7938957	4.4368395
##	897	898	899	900	901	902	903
##	11.5804256	4.0834236	4.6938801	12.0405176	6.4058300	16.3160590	8.2065935
##	904	905	906	907	908	909	910
##	10.6058037	5.6596803	13.3804486	6.4197483	10.5231494	8.7195983	1.7225153

##	911	912	913	914	915	916	917
##	17.6692826	8.9407439	2.2956488	3.2667472	1.9787172	2.0638933	13.6760796
##	918	919	920	921	922	923	924
##	5.5935925	1.5528793	6.1322960	7.1964918	21.3205025	2.6270650	7.5684903
##	925	926	927	928	929	930	931
##	1.3964291	21.1735949	18.2663614	17.4773056	8.5550614	18.6798891	7.9759518
##	932	933	934	935	936	937	938
##	8.0015782	17.4852457	15.3621537	7.3875057	15.4639053	7.0939226	7.2444014
##	939	940	941	942	943	944	945
##	17.5160521	27.6541974	4.3094194	7.4162540	4.2548757	8.1212024	17.0140749
##	946	947	948	949	950	951	952
##	4.0648014	6.0473304	4.6517644	16.6841986	2.6449438	10.7559174	3.6976706
##	953	954	955	956	957	958	959
##	2.4850477	9.7062606	17.5851431	3.4293814	10.6108722	3.4270308	1.4002080
##	960	961	962	963	964	965	966
##	8.6324446	4.8281421	2.2659616	8.4265628	4.6274592	8.6705762	10.3621217
##	967	968	969	970	971	972	973
##	10.8632748	1.0715042	6.6915335	13.4734660	9.3223893	15.8900530	0.9030003
##	974	975	976	977	978	979	980
##	20.2046905	21.5597588	11.3981694	8.5934782	5.5806089	14.6376527	4.2413443
##	981	982	983	984	985	986	987
##	1.4266780	10.1329876	4.7520801	9.7642424	7.4716962	13.7432387	5.4864822
##	988	989	990	991	992	993	994
##	1.3770556	4.7707851	2.0612435	1.6244282	6.4564054	16.4361366	15.9253967
##	995	996	997	998	999	1000	1001
##	11.8541703	3.5587026	10.2917675	7.9039957	8.8421109	6.2720709	1.7601186
##	1002	1003	1004	1005	1006	1007	1008
##	2.1214997	1.3539125	1.7411346	21.8338812	20.8574514	9.0459815	16.6019773
##	1009	1010	1011	1012	1013	1014	1015
##	13.1643961	3.7796824	7.4460682	11.3110712	4.8800157	14.2531636	17.1246443
##	1016	1017	1018	1019	1020	1021	1022
##	7.8863348	8.0184171	4.0628302	8.5157445	4.2664545	18.5752390	19.5944405
##	1023	1024	1025	1026	1027	1028	1029
##	8.9732826	2.0547237	7.9843352	7.2503888	10.2979881	6.9165223	9.3537670
##	1030	1031	1032	1033	1034	1035	1036
##	5.4069660	9.2515468	12.0038327	17.7142793	5.8463800	5.8268815	10.4684431
##	1037	1038	1039	1040	1041	1042	1043
##	1.4851818	8.8770769	7.1661810	13.7753395	6.0815835	3.2924341	21.7832082
##	1044	1045	1046	1047	1048	1049	1050
##	5.7733934	7.8165787	3.9542515	10.4917588	11.4499590	7.3105298	4.9428075
##	1051	1052	1053	1054	1055	1056	1057
##	13.9371014	4.7934635	7.2740165	6.0783940	5.1201871	4.1295619	8.7930229
##	1058	1059	1060	1061	1062	1063	1064
##	3.1324743	2.3711888	2.7294520	1.6492534	0.8402407	1.1625577	11.4086720
##	1065	1066	1067	1068	1069	1070	1071
##	19.2330412	3.3793043	8.1475060	4.8136578	7.9048726	19.1256716	14.5104842
##	1072	1073	1074	1075	1076	1077	1078
##	17.1472624	4.3213564	29.8038764	11.0134907	10.5877684	1.6352792	4.0254036
##	1079	1080	1081	1082	1083	1084	1085
##	6.7410791	4.3222492	15.1836923	16.3002302	8.9813608	18.9453111	6.3996928
##	1086	1087	1088	1089	1090	1091	1092
##	11.2621368	5.6862873	12.7138490	7.7354142	4.5172285	11.1213276	15.8356563

##	1093	1094	1095	1096	1097	1098	1099
##	10.4286484	2.7500589	6.5964112	9.1438074	2.0327193	4.1448355	16.2400189
##	1100	1101	1102	1103	1104	1105	1106
##	3.4575947	21.3275448	2.6760395	1.7461431	18.0247741	11.2860838	11.9799502
##	1107	1108	1109	1110	1111	1112	1113
##	2.0131956	5.2417538	2.5547582	14.4961698	9.7199854	8.3006573	5.5307133
##	1114	1115	1116	1117	1118	1119	1120
##	1.8653653	11.5019519	16.8487859	8.6120060	19.9353802	12.1248366	9.9002088
##	1121	1122	1123	1124	1125	1126	1127
##	7.9174818	10.1645673	6.5129278	2.3459002	9.3822469	5.4115414	6.8214519
##	1128	1129	1130	1131	1132	1133	1134
##	19.0154855	12.5584349	5.7437630	4.5131846	5.2190320	22.5101709	14.5211985
##	1135	1136	1137	1138	1139	1140	1141
##	19.0142445	16.9746805	12.0948127	15.2848226	7.1728767	15.6482119	8.2680463
##	1142	1143	1144	1145	1146	1147	1148
##	9.4339481	12.4026260	4.6618730	4.2073926	16.2833378	14.5147165	11.5057791
##	1149	1150	1151	1152	1153	1154	1155
##	11.0318334	0.8499801	6.6593277	7.2679984	12.1268440	17.5812111	15.7804894
##	1156	1157	1158	1159	1160	1161	1162
##	9.5662823	0.9603937	18.4956370	16.6318693	4.4436900	12.5083508	6.6747536
##	1163	1164	1165	1166	1167	1168	1169
##	14.1647899	3.6802844	22.3946298	7.8335325	27.3423464	11.4269620	9.7380798
##	1170	1171	1172	1173	1174	1175	1176
##	6.0062452	10.9420560	4.1386751	10.6585706	2.9847018	8.0794827	1.6354581
##	1177	1178	1179	1180	1181	1182	1183
##	12.4884952	5.6399297	21.0192058	5.8758658	10.0709375	9.8074010	16.6425681
##	1184	1185	1186	1187	1188	1189	1190
##	18.9470815	6.2951095	18.8747227	9.9719992	10.9061640	2.7100475	9.6448394
##	1191	1192	1193	1194	1195	1196	1197
##	6.7873976	4.1597932	3.8104164	14.9717190	14.1280031	2.7652638	11.4275083
##	1198	1199	1200	1201	1202	1203	1204
##	5.0248272	8.7924628	7.4123543	9.3559708	32.9441251	7.9829964	6.0477631
##	1205	1206	1207	1208	1209	1210	1211
##	13.2993579	9.3454209	7.9010394	1.7216629	7.6682088	11.2078980	13.4420536
##	1212	1213	1214	1215	1216	1217	1218
##	6.8125089	8.9979992	5.7491499	11.1189866	5.0795013	5.5926825	4.2229496
##	1219	1220	1221	1222	1223	1224	1225
##	25.7228590	3.7324963	2.0717642	13.9584818	6.4139696	5.4051954	25.6460412
##	1226	1227	1228	1229	1230	1231	1232
##	7.4705262	33.0075325	6.2099677	2.6487189	4.9070863	2.4700620	22.9052643
##	1233	1234	1235	1236	1237	1238	1239
##	7.4352017	10.4906458	10.5710308	15.3347389	8.5044286	0.7060949	19.8025992
##	1240	1241	1242	1243	1244	1245	1246
##	1.8867251	1.0566794	12.5806136	10.3370899	3.1409963	12.9309062	7.0057820
##	1247	1248	1249	1250	1251	1252	1253
##	2.8474322	21.0681374	3.0535307	14.6697405	2.3513661	7.7023419	1.2330831
##	1254	1255	1256	1257	1258	1259	1260
##	1.4921438	5.1126310	6.7749875	8.9181327	6.7015711	18.2508602	20.6143589
##	1261	1262	1263	1264	1265	1266	1267
##	14.9746560	11.9697991	3.7693932	18.6516697	10.7885384	6.3829624	12.1510131
##	1268	1269	1270	1271	1272	1273	1274
##	16.8483676	4.4110734	7.6298641	3.8206235	14.2009057	17.0245077	4.7877323

##	1275	1276	1277	1278	1279	1280	1281
##	3.7353453	20.3575012	12.4375459	1.6105797	10.5182508	5.2653338	14.1284608
##	1282	1283	1284	1285	1286	1287	1288
##	12.5705540	4.4917169	8.9765294	5.2361342	3.6967864	16.4186757	13.9115231
##	1289	1290	1291	1292	1293	1294	1295
##	0.9977380	11.2449393	3.7161619	19.8302160	3.9888562	4.4215189	3.7858406
##	1296	1297	1298	1299	1300	1301	1302
##	1.5471360	12.2846049	9.0972357	4.5058330	14.1896817	6.7507153	20.7261936
##	1303	1304	1305	1306	1307	1308	1309
##	10.0965310	13.4992918	2.9759504	4.3052096	2.7821999	8.4898494	3.1145392
##	1310	1311	1312	1313	1314	1315	1316
##	1.0991305	25.2769980	12.5023360	3.2950224	20.3227548	7.4227203	3.6889614
##	1317	1318	1319	1320	1321	1322	1323
##	1.6817200	14.6131848	13.3961881	2.3753915	11.9346755	6.6720660	31.6167688
##	1324	1325	1326	1327	1328	1329	1330
##	9.5519449	1.5885342	7.3298455	10.6622234	16.8281808	9.0100827	1.4498103
##	1331	1332	1333	1334	1335	1336	1337
##	9.7429608	6.3793634	15.7452417	1.7292177	5.9228430	4.2161524	7.1531510
##	1338	1339	1340	1341	1342	1343	1344
##	10.1639857	5.3302766	2.9887453	6.5687609	5.0318798	8.4651850	13.1986678
##	1345	1346	1347	1348	1349	1350	1351
##	4.1791514	7.1432006	15.3498377	15.0272215	1.3737976	6.5936612	12.8761269
##	1352	1353	1354	1355	1356	1357	1358
##	1.7646589	1.5147053	10.0049352	5.2591352	21.5630183	12.0508151	8.7587610
##	1359	1360	1361	1362	1363	1364	1365
##	19.4170701	8.4425186	10.0713076	15.4409711	9.4761406	9.6036573	4.0255766
##	1366	1367	1368	1369	1370	1371	1372
##	7.8451480	8.3534688	2.3840032	7.1278188	2.4992829	10.6989738	4.1474424
##	1373	1374	1375	1376	1377	1378	1379
##	7.0640035	29.1039334	7.4757798	15.1533135	4.2862415	8.2349630	8.1735130
##	1380	1381	1382	1383	1384	1385	1386
##	14.1361008	8.1802393	9.9365324	14.2570206	10.9984053	6.7735374	2.6035599
##	1387	1388	1389	1390	1391	1392	1393
##	5.7590476	11.6987741	4.6961000	7.6537240	14.7587590	4.0144357	8.6617917
##	1394	1395	1396	1397	1398	1399	1400
##	5.5482042	6.0134908	3.1130873	8.0591773	7.8932781	25.1127246	6.9500477
##	1401	1402	1403	1404	1405	1406	1407
##	2.3323873	11.5338894	2.5805394	12.2716068	12.0344098	3.6904143	13.9774053
##	1408	1409	1410	1411	1412	1413	1414
##	10.3482237	2.6701390	15.0530702	12.4803637	12.8773315	4.6980481	12.0136240
##	1415	1416	1417	1418	1419	1420	1421
##	2.7651220	7.7252179	15.8237615	9.5487234	8.4000836	10.5672691	5.6846202
##	1422	1423	1424	1425	1426	1427	1428
##	8.9802868	13.4988998	17.9576316	8.4687337	18.5723230	2.7220101	4.9585024
##	1429	1430	1431	1432	1433	1434	1435
##	11.3809370	11.4737522	11.7301460	12.1637590	19.1836807	10.2978075	2.1099525
##	1436	1437	1438	1439	1440	1441	1442
##	10.6718874	18.6396073	2.4376865	2.8879915	5.2950590	12.5802751	5.5974842
##	1443	1444	1445	1446	1447	1448	1449
##	10.3033209	10.3786546	7.1535618	9.9158334	3.2105663	23.7821925	10.6845951
##	1450	1451	1452	1453	1454	1455	1456
##	5.9935913	11.4823326	7.2037606	17.1021975	11.6239205	10.6971308	4.6253806



##	1457	1458	1459	1460	1461	1462	1463
##	2.2345406	7.7737755	3.4737191	2.1074921	3.2018455	21.8115587	26.9712870
##	1464	1465	1466	1467	1468	1469	1470
##	9.3739854	2.2217613	7.4830830	7.1601559	6.5677542	12.9218409	7.7395067
##	1471	1472	1473	1474	1475	1476	1477
##	4.2459131	1.7636212	6.7043691	9.6195343	4.7774713	5.6662065	9.6178537
##	1478	1479	1480	1481	1482	1483	1484
##	9.7831196	8.1796003	6.6476399	7.1703375	14.9203540	8.2680988	6.8768355
##	1485	1486	1487	1488	1489	1490	1491
##	6.9915295	1.3085480	6.0801406	2.9146808	9.2555699	20.5937122	20.3236742
##	1492	1493	1494	1495	1496	1497	1498
##	5.7238373	12.1106412	14.3644197	9.8708568	9.3390062	11.7173094	1.9903099
##	1499	1500	1501	1502	1503	1504	1505
##	8.6400419	4.6213684	3.8958603	10.9227095	11.3385548	5.8698855	2.5272597
##	1506	1507	1508	1509	1510	1511	1512
##	8.3755949	11.5493199	10.1028241	6.8489425	1.7127699	8.8031946	15.1783889
##	1513	1514	1515	1516	1517	1518	1519
##	8.0628150	7.7888345	6.6743454	53.6291156	61.4079715	63.0541731	66.0451410
##	1520	1521	1522	1523	1524	1525	1526
##	66.4925169	71.2353887	62.9533326	67.3724671	65.1506294	70.8873939	68.3496363
##	1527	1528	1529	1530	1531	1532	1533
##	55.6765382	66.3497520	71.3079335	62.0520101	44.5660583	71.2140373	70.2851745
##	1534	1535	1536	1537	1538	1539	1540
##	65.5195542	64.2409809	69.4928776	56.7980397	69.6872060	64.9599670	71.7501135
##	1541	1542	1543	1544	1545	1546	1547
##	60.7632934	50.7866194	61.1243959	66.9309025	56.1600023	60.0427128	63.8934641
##	1548	1549	1550	1551	1552	1553	1554
##	58.0186075	52.9783989	61.9900011	62.4113053	69.6529484	61.8342243	54.8150627
##	1555	1556	1557	1558	1559	1560	1561
##	52.8753059	42.5176349	47.5582390	53.8167126	68.4669809	63.1914135	54.9814164
##	1562	1563	1564	1565	1566	1567	1568
##	67.5694123	60.7479723	67.3809232	60.1756888	70.0949899	64.3909524	42.8831284
##	1569	1570	1571	1572	1573	1574	1575
##	61.3515418	63.8895186	71.7880819	65.6334797	71.7427113	49.4785235	71.0123934
##	1576	1577	1578	1579	1580	1581	1582
##	59.2577182	66.0513099	39.9338521	53.5647331	67.5002281	43.8339081	63.8828102
##	1583	1584	1585	1586	1587	1588	1589
##	64.9388664	45.4753104	59.4826367	55.0594154	67.4275680	55.1200006	42.0221659
##	1590	1591	1592	1593	1594	1595	1596
##	68.8510230	58.8186509	70.8989930	47.4335026	69.5555789	70.6186206	69.7225580
##	1597	1598	1599	1600	1601	1602	1603
##	65.8895385	49.2501703	46.1475357	67.0469730	59.3850623	69.7416261	37.8863543
##	1604	1605	1606	1607	1608	1609	1610
##	67.9481101	58.1557229	64.2707120	50.2806763	69.8511515	60.4257764	66.0916384
##	1611	1612	1613	1614	1615	1616	1617
##	50.2313931	59.1592253	44.4404586	44.6347915	69.3494852	50.1921705	60.0495311
##	1618	1619	1620	1621	1622	1623	1624
##	67.5834104	46.6989626	52.2284048	60.7667815	53.6376409	60.6294009	64.6039028
##	1625	1626	1627	1628	1629	1630	1631
##	53.7037903	49.6150483	46.3384690	53.0278305	43.3957573	50.7687509	67.3685916
##	1632	1633	1634	1635	1636	1637	1638
##	58.5211279	63.1747292	71.6120785	46.0470747	60.4973510	71.1176075	55.3131123

##	1639	1640	1641	1642	1643	1644	1645
##	59.3063372	56.9069576	61.5305298	66.5183675	45.3406106	65.7040468	56.8855540
##	1646	1647	1648	1649	1650	1651	1652
##	72.1274029	50.2823543	65.6429449	62.3798428	49.5708256	71.1998850	54.2003495
##	1653	1654	1655	1656	1657	1658	1659
##	65.4229572	37.8694564	57.3279122	70.0733718	53.2591454	65.4812710	60.8897683
##	1660	1661	1662	1663	1664	1665	1666
##	59.8632835	67.6561950	65.6937891	68.3613645	50.7596129	38.3517421	56.1308448
##	1667	1668	1669	1670	1671	1672	1673
##	69.1561799	61.6065089	64.2524739	54.8521127	67.3921771	61.9966410	57.8945134
##	1674	1675	1676	1677	1678	1679	1680
##	61.5972962	64.6871721	71.0540685	69.3818150	58.0098956	56.9609157	65.9706331
##	1681	1682	1683	1684	1685	1686	1687
##	61.3984928	65.9477087	58.2100864	48.1437641	62.8536739	53.2393774	56.3048743
##	1688	1689	1690	1691	1692	1693	1694
##	61.6483492	71.3697663	64.6932991	64.6370799	63.2662610	60.0439324	66.4399306
##	1695	1696	1697	1698	1699	1700	1701
##	40.6786971	62.8793176	70.6845884	57.6873583	59.2231796	61.2459545	60.9848047
##	1702	1703	1704	1705	1706	1707	1708
##	53.0752194	58.7762569	62.5806872	56.3996680	61.6385564	56.6027909	72.3325093
##	1709	1710	1711	1712	1713	1714	1715
##	68.1562767	63.9995086	66.7615800	62.3441582	42.1331974	60.9574689	71.4732047
##	1716	1717	1718	1719	1720	1721	1722
##	61.2026219	68.4295056	68.1170275	60.1479064	57.1724491	65.6389366	62.2007647
##	1723	1724	1725	1726	1727	1728	1729
##	70.0215310	63.4754860	56.1247682	60.1770758	54.9061900	62.8495990	65.0362042
##	1730	1731	1732	1733	1734	1735	1736
##	70.2951845	52.8459577	70.5866469	43.2365567	61.9620112	60.7442632	64.0419703
##	1737	1738	1739	1740	1741	1742	1743
##	64.3119658	61.6042844	61.0698873	57.5622332	50.8557045	67.9613635	55.1149969
##	1744	1745	1746	1747	1748	1749	1750
##	61.4925401	66.1336858	63.2516531	68.0120954	66.4306441	68.4432052	48.2133186
##	1751	1752	1753	1754	1755	1756	1757
##	65.6778378	58.3156716	69.3199750	70.7368634	50.5642460	61.1305840	66.2992935
##	1758	1759	1760	1761	1762	1763	1764
##	59.6289052	67.6659703	57.6908720	50.0314237	62.0065546	61.1183420	57.5991554
##	1765	1766	1767	1768	1769	1770	1771
##	68.9024962	48.0538818	71.6066861	63.2861104	60.1310813	47.3845132	48.2496704
##	1772	1773	1774	1775	1776	1777	1778
##	67.0003424	65.8877953	72.2344356	71.2022406	61.3316691	72.2114308	44.4722240
##	1779	1780	1781	1782	1783	1784	1785
##	70.3208956	63.8804604	46.1452447	40.3607800	66.5386993	56.0815861	61.9162632
##	1786	1787	1788	1789	1790	1791	1792
##	70.5184185	40.3376154	48.5125447	68.6775623	70.2360426	44.0442637	70.3168333
##	1793	1794	1795	1796	1797	1798	1799
##	60.6822388	53.5993313	65.2666482	57.8169761	55.1982338	56.0122075	46.7864206
##	1800	1801	1802	1803	1804	1805	1806
##	69.5077815	69.5468870	60.5828261	54.4336940	66.5141904	70.0842504	39.3466512
##	1807	1808	1809	1810	1811	1812	1813
##	69.6215839	52.5023033	66.9152311	47.0227143	68.7929243	66.0359915	61.3147710
##	1814	1815	1816	1817	1818	1819	1820
##	67.4758199	47.7268960	49.1404570	61.9523966	67.4928071	58.8326702	59.1597087

##	1821	1822	1823	1824	1825	1826	1827
##	71.6858462	56.2889057	65.0266488	63.4188389	63.7182685	60.1478886	68.9126570
##	1828	1829	1830	1831	1832	1833	1834
##	50.4016707	68.1729989	67.7796854	63.9046600	70.8793079	68.6529566	57.9503207
##	1835	1836	1837	1838	1839	1840	1841
##	42.3091940	60.3284021	41.8326364	66.7366304	64.7618408	64.4139034	61.4193627
##	1842	1843	1844	1845	1846	1847	1848
##	67.3086331	61.1139816	49.0141184	41.1508561	68.7211418	44.1115014	41.1773808
##	1849	1850	1851	1852	1853	1854	1855
##	63.0240165	56.5996894	70.3641345	62.9737608	64.1341511	64.4028805	63.9676792
##	1856	1857	1858	1859	1860	1861	1862
##	67.2874735	67.5748276	67.8242353	58.8241971	58.6883036	49.6936405	60.5762070
##	1863	1864	1865	1866	1867	1868	1869
##	47.7692190	59.3771360	71.3055413	49.1941591	56.6536699	67.6834076	50.4929965
##	1870	1871	1872	1873	1874	1875	1876
##	57.5354971	61.2060378	56.3536558	54.8662678	61.1313118	68.5224325	63.8698514
##	1877	1878	1879	1880	1881	1882	1883
##	71.2492584	48.4072273	51.7701662	62.9795620	62.3870188	68.5576014	61.9695626
##	1884	1885	1886	1887	1888	1889	1890
##	66.5040285	62.6695101	69.0914977	62.0144265	47.8732059	65.4893415	50.4528066
##	1891	1892	1893	1894	1895	1896	1897
##	64.4022735	71.1501726	56.3278579	60.6179560	62.6097793	58.0881449	67.3423593
##	1898	1899	1900	1901	1902	1903	1904
##	67.2765025	55.4335406	63.7674278	50.6735893	64.9090524	49.2488551	70.4403901
##	1905	1906	1907	1908	1909	1910	1911
##	64.3904697	60.4274383	69.8414389	43.0918982	67.7662938	57.3676791	63.7012202
##	1912	1913	1914	1915	1916	1917	1918
##	70.2661436	69.2782483	63.4310238	59.2712480	38.0931644	63.5134547	60.0781494
##	1919	1920	1921	1922	1923	1924	1925
##	62.3662008	72.2124268	69.1185985	46.6010716	60.0620607	60.3795596	65.1082852
##	1926	1927	1928	1929	1930	1931	1932
##	71.3461742	63.8438274	61.1358984	45.0949786	64.0510161	67.7576307	53.2248241
##	1933	1934	1935	1936	1937	1938	1939
##	48.3980958	51.8254378	38.6954900	60.3742992	67.6674273	64.7510302	68.7933628
##	1940	1941	1942	1943	1944	1945	1946
##	58.8857356	57.8949124	71.9683690	58.5560097	65.8315716	66.5278841	70.4590546
##	1947	1948	1949	1950	1951	1952	1953
##	61.4703132	50.6710334	59.1839799	49.5597741	62.9891527	68.5955846	65.2386676
##	1954	1955	1956	1957	1958	1959	1960
##	68.7932548	62.8504977	51.3158185	57.2197336	45.3082889	60.0042419	68.8241411
##	1961	1962	1963	1964	1965	1966	1967
##	55.9209676	47.8381613	54.9037668	63.0310534	68.6935274	71.1095135	54.7412751
##	1968	1969	1970	1971	1972	1973	1974
##	71.6218874	69.0407309	62.0048304	65.2190341	63.1537035	68.6153688	55.0424817
##	1975	1976	1977	1978	1979	1980	1981
##	62.4615155	39.8414765	70.9548381	70.1243735	57.1692547	46.7115502	66.3627401
##	1982	1983	1984	1985	1986	1987	1988
##	40.7010232	62.0492952	56.4519600	42.2468436	49.5944933	67.3451562	46.0381388
##	1989	1990	1991	1992	1993	1994	1995
##	49.0311937	58.1021211	47.8738819	60.1706476	62.6772177	60.9154094	54.8043315
##	1996	1997	1998	1999	2000	2001	2002
##	63.8114775	68.0941230	56.4653863	56.9376273	60.0943083	67.7535580	70.5638611

##	2003	2004	2005	2006	2007	2008	2009
##	63.1038452	63.5633086	64.2059036	52.8432798	58.3296291	66.0490261	61.5811246
##	2010	2011	2012	2013	2014	2015	2016
##	69.9514314	45.7462941	69.2742701	69.3381618	59.4426026	66.9393291	53.7484962
##	2017	2018	2019	2020	2021	2022	2023
##	59.7125228	39.7577160	56.3380750	48.4687431	50.7045643	50.4344649	68.2233956
##	2024	2025	2026	2027	2028	2029	2030
##	69.3195501	59.8098178	68.3923107	64.9314914	50.6621608	59.0741247	64.1280889
##	2031	2032	2033	2034	2035	2036	2037
##	57.7011861	58.6493203	65.3806758	64.4803072	52.0137710	39.8411104	59.1023043
##	2038	2039	2040	2041	2042	2043	2044
##	70.7720919	65.1926169	57.7246603	58.7023947	61.9177290	59.4045605	62.6150531
##	2045	2046	2047	2048	2049	2050	2051
##	65.0576728	57.6076011	45.7674890	46.7661080	69.1285418	67.5208574	56.2409294
##	2052	2053	2054	2055	2056	2057	2058
##	65.4660918	54.1891826	71.6261281	70.3259371	64.3978577	45.3475385	67.3210041
##	2059	2060	2061	2062	2063	2064	2065
##	49.5015321	53.7636652	64.9857452	54.3118128	65.0149740	71.3111716	69.6535576
##	2066	2067	2068	2069	2070	2071	2072
##	71.8314590	51.0234771	68.4041830	62.6503008	65.0926459	45.6898467	64.7879435
##	2073	2074	2075	2076	2077	2078	2079
##	58.1529877	50.1845922	60.7873479	51.9306459	51.5820856	50.6753453	65.1426477
##	2080	2081	2082	2083	2084	2085	2086
##	71.4947042	62.7789603	72.2256069	66.1058303	48.1834183	67.9082788	64.5265356
##	2087	2088	2089	2090	2091	2092	2093
##	59.9008088	71.0564810	68.1497003	61.6135796	54.4582200	55.2224818	61.0821162
##	2094	2095	2096	2097	2098	2099	2100
##	70.4249981	58.2584330	65.8141951	68.5493718	54.9991015	62.6957691	43.1244481
##	2101	2102	2103	2104	2105	2106	2107
##	67.8664328	66.5863280	71.5476657	62.7466428	45.9926239	69.9093941	42.7321545
##	2108	2109	2110	2111	2112	2113	2114
##	61.3957844	48.0821496	66.7072430	57.2968929	67.1637255	51.0590327	55.4160383
##	2115	2116	2117	2118	2119	2120	2121
##	69.8394554	70.2758048	66.1766124	57.9098690	66.3282410	67.0427759	54.7510956
##	2122	2123	2124	2125	2126	2127	2128
##	56.3096032	60.5456097	60.7881925	55.8234469	70.5137158	69.2887658	70.9445349
##	2129	2130	2131	2132	2133	2134	2135
##	71.4278351	70.2620997	56.7426674	42.9607325	56.1791913	60.0902685	66.4755213
##	2136	2137	2138	2139	2140	2141	2142
##	69.2523655	67.7915573	38.2796755	65.6220014	70.9957184	51.3294450	61.2445152
##	2143	2144	2145	2146	2147	2148	2149
##	52.4148032	67.2872555	43.2379156	41.2829693	71.2776037	56.1274917	69.3658012
##	2150	2151	2152	2153	2154	2155	2156
##	54.6634581	58.5186315	63.4381163	62.7759339	69.9950707	65.8015995	64.0188822
##	2157	2158	2159	2160	2161	2162	2163
##	54.2709970	71.3393404	57.7825281	62.9210626	63.1614549	63.2515656	56.7000498
##	2164	2165	2166	2167	2168	2169	2170
##	70.2909972	52.6158067	58.1351169	71.5653406	68.7346679	66.8965855	64.1071694
##	2171	2172	2173	2174	2175	2176	2177
##	60.7744878	61.3173525	64.4946473	65.9350316	48.3904847	57.9338568	43.3981007
##	2178	2179	2180	2181	2182	2183	2184
##	69.4009375	53.3568289	67.0919174	47.3649976	54.5450471	70.1320389	70.5375878

##	2185	2186	2187	2188	2189	2190	2191
##	63.8910532	71.3715021	69.2449602	50.6601293	66.4251239	69.5622613	70.3961747
##	2192	2193	2194	2195	2196	2197	2198
##	71.7985730	68.2051789	51.8747500	53.4938390	58.7832305	57.0949336	69.9164854
##	2199	2200	2201	2202	2203	2204	2205
##	70.4608937	56.9977688	63.0192645	67.4605612	64.5987696	63.6527001	68.5298047
##	2206	2207	2208	2209	2210	2211	2212
##	56.1106529	45.8014245	61.5409164	62.3931363	52.3399267	56.9581854	63.4317051
##	2213	2214	2215	2216	2217	2218	2219
##	49.4581375	63.0659409	52.8815342	45.4145319	69.5438711	56.4853201	46.8790865
##	2220	2221	2222	2223	2224	2225	2226
##	48.2232088	56.3687250	70.5172101	45.3082685	56.3846303	63.4495036	60.5394701
##	2227	2228	2229	2230	2231	2232	2233
##	43.4932031	66.2887592	64.4257598	64.3165514	56.1670330	58.9354141	66.0141556
##	2234	2235	2236	2237	2238	2239	2240
##	68.5000979	58.9931973	40.7248981	68.1823135	71.2958992	59.3597798	66.9285487
##	2241	2242	2243	2244	2245	2246	2247
##	59.3654813	62.1524364	63.1424715	46.0895984	62.1622371	61.1553450	53.3958181
##	2248	2249	2250	2251	2252	2253	2254
##	66.5156923	68.6186037	47.7228990	47.7879751	70.6103831	65.1037355	67.4579445
##	2255	2256	2257	2258	2259	2260	2261
##	46.6741938	64.6917513	65.0398919	66.4862136	62.1023615	67.1468118	50.3971346
##	2262	2263	2264	2265	2266	2267	2268
##	51.4228695	67.1445586	46.7153541	68.1300834	55.8880672	58.7515971	65.1847672
##	2269	2270	2271	2272	2273	2274	2275
##	49.7330800	66.2536782	56.1520314	57.9055889	65.4987806	63.1123277	61.7817740
##	2276	2277	2278	2279	2280	2281	2282
##	67.2788326	54.6532368	57.1944937	38.5647587	46.9994007	69.7186510	44.3403263
##	2283	2284	2285	2286	2287	2288	2289
##	70.5840010	51.0636242	52.7895538	56.4127315	59.6394550	66.7158047	58.7352784
##	2290	2291	2292	2293	2294	2295	2296
##	62.4284822	46.0635243	46.4999921	70.4683350	62.9363354	68.6416105	58.0968776
##	2297	2298	2299	2300	2301	2302	2303
##	62.2815399	58.6246525	69.1225470	57.1778438	63.2771673	70.6100977	55.8008130
##	2304	2305	2306	2307	2308	2309	2310
##	50.2846517	38.9044319	66.7539521	50.2635524	58.3465154	59.4398322	63.7011058
##	2311	2312	2313	2314	2315	2316	2317
##	71.1095024	58.9759233	63.5718493	70.8385451	72.1715936	70.2128922	69.5669685
##	2318	2319	2320	2321	2322	2323	2324
##	60.8768339	55.4884556	38.2648272	58.1271124	45.0154550	61.6166494	61.2038533
##	2325	2326	2327	2328	2329	2330	2331
##	69.1214611	59.5185797	66.3954678	71.6811892	59.0916814	66.4063305	68.7407134
##	2332	2333	2334	2335	2336	2337	2338
##	69.8593135	57.4216601	56.8880627	57.8890712	50.8581376	54.7676977	62.2461269
##	2339	2340	2341	2342	2343	2344	2345
##	71.7954231	61.2925696	47.2616812	70.9749753	70.8380352	68.1717765	37.6031582
##	2346	2347	2348	2349	2350	2351	2352
##	54.3753017	67.0882995	62.4267458	56.7322143	63.3088111	57.9413272	41.4687023
##	2353	2354	2355	2356	2357	2358	2359
##	71.3781471	49.9505075	66.2902697	71.7094908	66.8511931	58.3228649	70.4194966
##	2360	2361	2362	2363	2364	2365	2366
##	65.7528494	54.5669929	51.7342122	67.2334585	48.0841830	66.4351215	64.2041754

##	2367	2368	2369	2370	2371	2372	2373
##	65.8409679	59.1952306	56.7132941	57.1494531	65.6823780	68.4311077	50.5322929
##	2374	2375	2376	2377	2378	2379	2380
##	70.1145178	62.7239040	70.6088531	57.4051836	57.7004668	51.2801435	53.4884103
##	2381	2382	2383	2384	2385	2386	2387
##	62.7730933	64.1789767	52.4095093	62.5492886	54.1938985	54.3275681	52.1565049
##	2388	2389	2390	2391	2392	2393	2394
##	47.6725452	64.1356581	68.4597560	51.2717694	63.6800029	70.4417305	47.9336860
##	2395	2396	2397	2398	2399	2400	2401
##	65.3101381	51.2612080	70.2036009	58.0787952	65.0986538	62.0024876	68.0098679
##	2402	2403	2404	2405	2406	2407	2408
##	68.9809560	70.8228216	69.8453679	63.5726955	70.9105158	67.9338834	59.1050290
##	2409	2410	2411	2412	2413	2414	2415
##	51.5603890	59.7153227	52.5404905	65.9437210	63.4633127	68.8840869	68.1261112
##	2416	2417	2418	2419	2420	2421	2422
##	70.3013010	55.5537362	70.2328196	68.8056321	66.1983256	38.4481659	52.1604230
##	2423	2424	2425	2426	2427	2428	2429
##	51.7180231	52.4559026	65.3051797	63.4848885	69.8060802	48.4704479	67.0123362
##	2430	2431	2432	2433	2434	2435	2436
##	60.9238137	67.4444200	54.0561699	66.2046988	67.9791795	68.4985059	66.5831082
##	2437	2438	2439	2440	2441	2442	2443
##	63.5801138	46.9786135	58.3091755	48.3491648	41.8232128	65.8747616	67.8028842
##	2444	2445	2446	2447	2448	2449	2450
##	50.1280540	61.1428181	39.2909235	58.6579363	67.4897134	69.2614219	69.2910407
##	2451	2452	2453	2454	2455	2456	2457
##	50.4645728	57.9036565	70.8907628	68.0896385	55.8284820	63.2895480	65.6724507
##	2458	2459	2460	2461	2462	2463	2464
##	54.3652924	69.8518657	69.7987009	71.0931799	55.5368281	59.3838824	65.0370579
##	2465	2466	2467	2468	2469	2470	2471
##	71.2843503	56.6088850	45.7082060	56.7816751	69.9279275	42.7845493	64.3136184
##	2472	2473	2474	2475	2476	2477	2478
##	64.2896019	70.2374386	44.1784407	67.7071264	68.2446937	52.5585626	49.8660044
##	2479	2480	2481	2482	2483	2484	2485
##	44.7814038	56.8322937	68.9204221	64.4125320	61.0152640	49.8962783	71.9110935
##	2486	2487	2488	2489	2490	2491	2492
##	50.7960032	54.9190922	71.3313445	46.3582971	70.1113092	61.7444406	58.5772195
##	2493	2494	2495	2496	2497	2498	2499
##	63.3474255	63.0757641	58.5003563	52.2360329	54.4539963	54.9549320	70.7364239
##	2500	2501	2502	2503	2504	2505	2506
##	59.0868608	70.1311993	56.9517916	65.6144456	54.5320903	61.7251391	67.1647289
##	2507	2508	2509	2510	2511	2512	2513
##	71.5167283	65.4488556	62.3037014	52.8138425	64.1563123	46.0635358	48.2925196
##	2514	2515	2516	2517	2518	2519	2520
##	66.4391771	66.5605199	64.7125981	67.9142542	43.2473322	42.0716851	44.9934716
##	2521	2522	2523	2524	2525	2526	2527
##	52.3430417	58.9208562	70.1769355	43.8711544	70.1984224	48.3010973	59.1489664
##	2528	2529	2530	2531	2532	2533	2534
##	55.4151133	61.9001037	58.7285395	43.2786011	46.3915412	42.1313255	54.0884572
##	2535	2536	2537	2538	2539	2540	2541
##	54.4907495	65.2148274	71.4529286	47.3344541	61.0412744	43.1538454	56.3169992
##	2542	2543	2544	2545	2546	2547	2548
##	67.9484910	67.6108142	70.5859549	69.2502413	62.2951255	69.6639234	72.4066401

##	2549	2550	2551	2552	2553	2554	2555
##	50.2334396	53.0520460	61.3257929	62.0643529	54.3232543	55.2415838	50.4106295
##	2556	2557	2558	2559	2560	2561	2562
##	65.6156298	70.9251837	68.7926761	65.0218329	56.9508194	66.5907952	64.7405285
##	2563	2564	2565	2566	2567	2568	2569
##	55.7797149	69.2290465	59.3656653	45.9696832	70.7550365	59.8105561	66.9798974
##	2570	2571	2572	2573	2574	2575	2576
##	68.4313682	45.0952935	64.7082285	61.8496943	63.5957682	65.2445454	61.5299999
##	2577	2578	2579	2580	2581	2582	2583
##	60.1431834	39.0458560	71.2355079	67.2367507	62.7951909	64.6470362	71.1403615
##	2584	2585	2586	2587	2588	2589	2590
##	67.5359840	65.5638744	55.8516631	70.6885931	58.7476517	43.1736027	49.5705582
##	2591	2592	2593	2594	2595	2596	2597
##	69.9863113	57.1324934	70.4337293	41.5735741	57.8605731	55.6343682	62.4706951
##	2598	2599	2600	2601	2602	2603	2604
##	64.6539599	49.6884494	71.9488405	51.3846418	42.3116149	63.0003684	55.4839704
##	2605	2606	2607	2608	2609	2610	2611
##	71.6412138	46.4395518	65.1520474	54.6278490	69.6631832	67.3333714	71.5664621
##	2612	2613	2614	2615	2616	2617	2618
##	39.1605339	43.0746752	66.4850596	49.3135272	70.8127517	70.6298915	63.3371692
##	2619	2620	2621	2622	2623	2624	2625
##	52.1969462	55.2946425	47.8057761	55.3141670	71.3231764	68.2146239	63.0744016
##	2626	2627	2628	2629	2630	2631	2632
##	64.7624904	54.5264238	55.7775378	42.2388432	56.5751962	69.0217139	37.8933007
##	2633	2634	2635	2636	2637	2638	2639
##	50.8526965	45.8587739	69.3908955	70.0722647	39.8290935	58.5375414	71.4628910
##	2640	2641	2642	2643	2644	2645	2646
##	50.8124663	56.6490632	50.6805843	71.6448994	67.9554629	69.0743445	65.7854893
##	2647	2648	2649	2650	2651	2652	2653
##	68.4071188	47.8263809	47.5945507	71.2935242	59.9043965	58.3254814	55.8774351
##	2654	2655	2656	2657	2658	2659	2660
##	63.1100693	58.3083946	68.8349625	70.1692035	69.1083349	70.0235617	61.5918141
##	2661	2662	2663	2664	2665	2666	2667
##	57.1972499	42.4313238	59.6649598	71.7583936	54.8404326	53.8676251	62.9994610
##	2668	2669	2670	2671	2672	2673	2674
##	70.3241688	67.5784584	51.1950005	63.0045363	69.2259948	64.9246308	71.0929097
##	2675	2676	2677	2678	2679	2680	2681
##	64.4021698	54.5688773	42.8991239	57.9023491	66.9681491	57.7998837	60.3228599
##	2682	2683	2684	2685	2686	2687	2688
##	70.8702153	68.3636108	46.2179496	56.6225319	70.1519809	62.6344420	59.2446989
##	2689	2690	2691	2692	2693	2694	2695
##	71.5765094	65.7754035	56.3137484	65.9270635	51.6841458	44.8867446	36.5447637
##	2696	2697	2698	2699	2700	2701	2702
##	71.3488174	64.4141974	69.5495425	70.3444324	71.0784257	69.2778995	62.0059071
##	2703	2704	2705	2706	2707	2708	2709
##	57.2310872	64.6083956	62.4283886	70.2850307	68.2763467	42.3930069	56.8714478
##	2710	2711	2712	2713	2714	2715	2716
##	61.5452228	68.6529341	38.5601269	56.7539292	70.8119241	67.3626952	63.1298926
##	2717	2718	2719	2720	2721	2722	2723
##	46.0222519	66.8510873	69.2443635	60.5867876	60.3802407	72.3122331	61.4575640
##	2724	2725	2726	2727	2728	2729	2730
##	64.8652755	64.3143554	60.9212649	70.2121957	57.5408114	64.8156414	58.6034720

##	2731	2732	2733	2734	2735	2736	2737
##	62.0367363	56.1974769	64.9540768	42.3184220	60.5095339	54.5631986	56.0489798
##	2738	2739	2740	2741	2742	2743	2744
##	71.6516606	58.7733165	59.0754912	37.9512790	66.2396253	59.3660475	64.4217091
##	2745	2746	2747	2748	2749	2750	2751
##	60.0563612	70.5752809	45.8567369	71.5497538	61.9295242	62.5484437	62.4183217
##	2752	2753	2754	2755	2756	2757	2758
##	40.1473515	56.1719501	39.2210590	55.4929660	64.9127843	63.2721911	49.6097315
##	2759	2760	2761	2762	2763	2764	2765
##	71.4701199	56.4043824	61.8457689	67.3149852	52.0983915	71.2865904	53.1944891
##	2766	2767	2768	2769	2770	2771	2772
##	56.5578474	66.5253988	53.4584698	71.1877173	59.0954524	61.0967703	68.2569869
##	2773	2774	2775	2776	2777	2778	2779
##	60.4044098	50.5951160	66.3426824	68.0221686	65.6595643	69.6762709	63.1459011
##	2780	2781	2782	2783	2784	2785	2786
##	52.4903908	57.7935654	50.7780172	63.7843571	62.8590470	68.2999886	57.4434219
##	2787	2788	2789	2790	2791	2792	2793
##	64.1384398	60.3247392	54.6039621	51.9714043	64.5389000	59.4493547	48.4377663
##	2794	2795	2796	2797	2798	2799	2800
##	66.9020109	58.9868083	63.6398751	63.6023138	54.4070185	37.1671734	57.0411777
##	2801	2802	2803	2804	2805	2806	2807
##	66.4320068	55.9671171	70.6912960	65.0380600	49.4939422	60.2250264	61.9001428
##	2808	2809	2810	2811	2812	2813	2814
##	58.7374452	69.7960247	59.3399360	69.6575431	63.4610437	56.5597066	64.5921661
##	2815	2816	2817	2818	2819	2820	2821
##	56.1516941	56.8594628	67.2561503	62.8616526	49.5570357	41.3767154	61.8134177
##	2822	2823	2824	2825	2826	2827	2828
##	49.2492091	56.6333513	56.3639876	70.9627708	67.5640823	67.8057308	53.2207995
##	2829	2830	2831	2832	2833	2834	2835
##	64.6089286	53.3406667	71.1280137	68.4360399	54.3049418	59.0757425	52.0675008
##	2836	2837	2838	2839	2840	2841	2842
##	48.7200470	69.0683988	66.9868661	54.4054926	63.6315168	53.8700077	59.8926314
##	2843	2844	2845	2846	2847	2848	2849
##	67.0417660	72.2183136	68.1742946	58.7483306	58.1310357	55.2871053	56.1695371
##	2850	2851	2852	2853	2854	2855	2856
##	59.3624948	51.2414539	68.0098436	58.2673351	66.9027834	60.7626728	58.6225553
##	2857	2858	2859	2860	2861	2862	2863
##	67.8582884	55.8881743	66.3032317	57.0165411	60.1748512	64.8680024	67.8429092
##	2864	2865	2866	2867	2868	2869	2870
##	53.1982866	60.5088526	63.5048363	46.4805316	54.8585096	60.9104027	67.0838821
##	2871	2872	2873	2874	2875	2876	2877
##	62.8597416	62.7638543	65.9699495	59.9750078	58.1293251	60.7203170	69.4960141
##	2878	2879	2880	2881	2882	2883	2884
##	67.3077701	64.7174330	58.6041693	46.8468927	71.2578406	70.4183112	68.2893025
##	2885	2886	2887	2888	2889	2890	2891
##	52.4033282	40.2686274	47.1414345	64.4435307	66.5565253	42.0495344	63.9793804
##	2892	2893	2894	2895	2896	2897	2898
##	59.9770604	65.4466780	61.0116692	69.1558043	68.8490393	52.6970240	61.3406708
##	2899	2900	2901	2902	2903	2904	2905
##	59.2636267	66.3046523	70.7130504	46.6744508	63.3865307	54.1017339	65.8056791
##	2906	2907	2908	2909	2910	2911	2912
##	70.8458959	62.2257141	63.2349234	46.6417317	53.2236999	53.7979776	64.9876511



##	2913	2914	2915	2916	2917	2918	2919
##	66.7689197	68.1378969	60.0576603	43.8219025	49.2070239	59.4371253	70.5381327
##	2920	2921	2922	2923	2924	2925	2926
##	71.9905125	62.9911239	60.2817249	69.7053950	68.6188509	66.8175882	43.9555945
##	2927	2928	2929	2930	2931	2932	2933
##	62.8614269	65.1071845	68.4341036	60.5403915	71.6330010	69.7738588	62.4527152
##	2934	2935	2936	2937	2938	2939	2940
##	70.4538244	70.8371290	51.0744398	70.9504382	40.8363731	57.3837518	56.9259496
##	2941	2942	2943	2944	2945	2946	2947
##	52.2219364	55.1289067	58.1773577	66.1842291	60.5344812	57.9940386	68.2415005
##	2948	2949	2950	2951	2952	2953	2954
##	53.4110048	46.0695487	62.2193727	62.4909356	59.0288715	52.2666886	55.1736475
##	2955	2956	2957	2958	2959	2960	2961
##	54.5993953	59.0992143	68.0996566	63.1797198	67.7854832	40.5287236	63.4031093
##	2962	2963	2964	2965	2966	2967	2968
##	66.8488516	61.1817791	71.5493835	71.7591339	50.4722209	64.1447938	60.5079983
##	2969	2970	2971	2972	2973	2974	2975
##	69.2009635	64.7646216	55.1597864	65.3825605	71.1329317	57.7247217	67.3267038
##	2976	2977	2978	2979	2980	2981	2982
##	37.3954256	48.6521999	62.3260930	57.2947436	61.4488460	52.2691874	72.0902335
##	2983	2984	2985	2986	2987	2988	2989
##	71.7097082	59.6538794	70.3546317	53.0490143	66.8530116	59.0947280	60.8518476
##	2990	2991	2992	2993	2994	2995	2996
##	47.1146936	64.4229594	55.5058729	68.0045777	58.3351529	48.4690664	54.9790977
##	2997	2998	2999	3000			
##	55.0890914	56.0780708	60.6309427	63.1527707			

## Part V: Data Summary and Implications

**F1.** In this model, the Y-intercept is not particularly meaningful because many of the variables do not have practical interpretations when equal to zero. For example, an age of zero would imply the presence of customers who are newborns, which is unrealistic. Additionally, some variables are binary, where a value of zero represents “No.” In other words, when all predictors are zero, the expected value of tenure would be -6.787 months, which doesn’t make sense. So the Y-intercept in this context is not meaningful.

The model has a statistically significant p-value meaning that I can reject the null hypothesis that the predictors have no effect on tenure. In this particular model, InternetServiceFiber Optic and InternetServiceNone have the highest positive coefficients (5.055 and 5.054) meaning that the customers with fiber optic service or no internet service are associated with higher tenure. In contrast, it appears that the two variables with the most negative coefficients, StreamingTV1 and StreamingMovies1 (-2.783 and -2.564) are both associated with customers who have lower tenure.

**F2.** This model can identify discrepancies between predicted and actual customer tenure, which is critical for mitigating churn. For example, if the model predicts a customer’s tenure to be 18 months, but their actual tenure reaches 24 months, it could signal imminent churn. In such cases, the company should take proactive measures such as offering service upgrades, discounts, or addressing potential dissatisfaction to retain the customer. Similarly, if a customer is predicted to stay for 24 months, but by 18 months their usage declines or their customer service calls increase, this could indicate early signs of churn that require prompt intervention.

Additionally, the model can predict expected tenure for new customers based on demographics and service usage patterns. Insights from key predictors, such as the positive impact of “*InternetServiceFiber Optic*” and the negative impact of “*StreamingTV*,” enable the company to tailor offerings. For example, promoting fiber-optic services or improving streaming-related issues could enhance retention among customers with a higher risk of shorter tenure.

## Part VI: Demonstration

**G.** A link to the panopto demonstration video will be included in the uploaded documents.

**H:** Web Sources:

1. **Bobbitt, Z. (2019, March 10).** Multicollinearity in regression. Statology. Retrieved November 17, 2024, from <https://www.statology.org/multicollinearity-regression/> (<https://www.statology.org/multicollinearity-regression/>)
2. **Bobbitt, Z. (2020, January 8).** The four assumptions of linear regression. Statology. Retrieved November 17, 2024, from <https://www.statology.org/linear-regression-assumptions/> (<https://www.statology.org/linear-regression-assumptions/>)
4. **Çetinkaya-Rundel, M., Hardin, J., & Horton, N. J. (2021).** Dummy variables and interactions. Modern Statistics with R. Retrieved December 4, 2024, from <https://www.modernstatisticswithr.com/regression.html#dummy> (<https://www.modernstatisticswithr.com/regression.html#dummy>)
5. **Gallo, A. (2014, October 29).** The value of keeping the right customers. Harvard Business Review. Retrieved November 17, 2024, from <https://hbr.org/2014/10/the-value-of-keeping-the-right-customers> (<https://hbr.org/2014/10/the-value-of-keeping-the-right-customers>)
6. **Ihaka, R. (n.d.).** The R Project: A brief history and thoughts about the future (p. 12). The University of Auckland. Retrieved November 17, 2024, from <https://www.stat.auckland.ac.nz/~ihaka/downloads/Otago.pdf> (<https://www.stat.auckland.ac.nz/~ihaka/downloads/Otago.pdf>)
7. **Larose, C. D., & Larose, D. T. (2019).** Data science using Python and R. Wiley. Retrieved from [https://eds.p.ebscohost.com/eds/ebookviewer/ebook/bmxlYmtfXzlwOTEzNzFfX0FO0?sid=04ef9475-3bed-4dbe-8317-a1c5eb6da3cb@redis&vid=0&format=EB&lpid=lp\\_151&rid=0](https://eds.p.ebscohost.com/eds/ebookviewer/ebook/bmxlYmtfXzlwOTEzNzFfX0FO0?sid=04ef9475-3bed-4dbe-8317-a1c5eb6da3cb@redis&vid=0&format=EB&lpid=lp_151&rid=0) ([https://eds.p.ebscohost.com/eds/ebookviewer/ebook/bmxlYmtfXzlwOTEzNzFfX0FO0?sid=04ef9475-3bed-4dbe-8317-a1c5eb6da3cb@redis&vid=0&format=EB&lpid=lp\\_151&rid=0](https://eds.p.ebscohost.com/eds/ebookviewer/ebook/bmxlYmtfXzlwOTEzNzFfX0FO0?sid=04ef9475-3bed-4dbe-8317-a1c5eb6da3cb@redis&vid=0&format=EB&lpid=lp_151&rid=0))
8. **Martin, G. [R Programming 101]. (n.d.).** Multiple regression - Making sure that your assumptions are met [Video]. YouTube. <https://www.youtube.com/watch?v=1lwvNLDSu0s&t=1092s> (<https://www.youtube.com/watch?v=1lwvNLDSu0s&t=1092s>)