

call_center_analysis.R

rivka

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```
data <- read.csv('Call_Center.csv')

### first question: "can we predict the call duration and how accurate can it be?"
###(we can apply this model in predicting waiting time on the phone line so that costumers can be informed)

# check data structure and assign correct data type for each variable
str(data)
```

```
## 'data.frame': 32941 obs. of 12 variables:
## $ Id : chr "DKK-57076809-w-055481-fU" "QGK-72219678-w-102139-KY" "GYJ-3002593..."
## $ Call.Timestamp : chr "10/29/20 0:00" "10/5/20 0:00" "10/4/20 0:00" "10/17/20 0:00" ...
## $ Call.Centres.City : chr "Los Angeles" "Baltimore" "Los Angeles" "Los Angeles" ...
## $ Channel : chr "Call-Center" "Chatbot" "Call-Center" "Chatbot" ...
## $ City : chr "Detroit" "Spartanburg" "Gainesville" "Portland" ...
## $ Customer.Name : chr "Analise Gairdner" "Crichton Kidsley" "Averill Brundrett" "Noreen ..."
## $ Reason : chr "Billing Question" "Service Outage" "Billing Question" "Billing Question" ...
## $ Response.Time : chr "Within SLA" "Within SLA" "Above SLA" "Within SLA" ...
## $ Sentiment : chr "Neutral" "Very Positive" "Negative" "Very Negative" ...
## $ State : chr "Michigan" "South Carolina" "Florida" "Oregon" ...
## $ Call.Duration.In.Minutes: int 17 23 45 12 23 25 31 37 37 12 ...
## $ Csat.Score : int 7 NA NA 1 NA 5 8 NA NA NA ...
```

```
data$Channel <- as.factor(data$Channel)
data$Reason <- as.factor(data$Reason)
data$State <- as.factor(data$State)
data$Sentiment <- as.factor(data$Sentiment)
data$Call.Centres.City <- as.factor(data$Call.Centres.City)
data$City <- as.factor(data$City)

sapply(data, function(x) length(unique(x)))
```

```
##           Id           Call.Timestamp           Call.Centres.City
##           32941                    31                    4
##           Channel           City           Customer.Name
##           4                461                32941
##           Reason           Response.Time           Sentiment
##           3                3                5
##           State Call.Duration.In.Minutes           Csat.Score
##           51                41                11
```

```

### because of the complexity of the data, fitting the full data into a linear function is too much for
#identify correlation so we can pick important variables
# calculate the correlation between Call.Duration.In.Minutes and other numeric variables
cor(data$Call.Duration.In.Minutes,data$Csat.Score, use = "complete.obs") #only Csat.Score is another nu

```

```
## [1] -0.00997329
```

```

# Perform ANOVA for each categorical variable
categorical_columns <- sapply(data, is.factor) # Identify categorical columns
aov_results <- lapply(data[, categorical_columns], function(x) {
  aov(Call.Duration.In.Minutes ~ x, data = data)
})

# View ANOVA results for each categorical variable
aov_summary <- lapply(aov_results, summary)
print(aov_summary)

```

```

## $Call.Centres.City
##              Df Sum Sq Mean Sq F value Pr(>F)
## x              3      62   20.69   0.148  0.931
## Residuals    32937 4599120   139.63
##
## $Channel
##              Df Sum Sq Mean Sq F value Pr(>F)
## x              3     140   46.65   0.334  0.801
## Residuals    32937 4599042   139.63
##
## $City
##              Df Sum Sq Mean Sq F value Pr(>F)
## x            460   68405   148.7   1.066  0.16
## Residuals    32480 4530777   139.5
##
## $Reason
##              Df Sum Sq Mean Sq F value Pr(>F)
## x              2     213   106.7   0.764  0.466
## Residuals    32938 4598969   139.6
##
## $Sentiment
##              Df Sum Sq Mean Sq F value Pr(>F)
## x              4    1056   264.0   1.891  0.109
## Residuals    32936 4598126   139.6
##
## $State
##              Df Sum Sq Mean Sq F value Pr(>F)
## x             50     7542   150.8   1.081  0.323
## Residuals    32890 4591640   139.6

```

```

### results show that there are no variables with significant effect on duration...
### though it shows that sentiment, city, state, reason have the best (from best to worse order) correl.
library(dplyr)

```

```
## Warning: package 'dplyr' was built under R version 4.4.2
```

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

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

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

# Select the columns you want to keep
selected_data <- select(data, Call.Duration.In.Minutes, City, Sentiment, State, Reason)

#install.packages("caret")
library(rsample)

## Warning: package 'rsample' was built under R version 4.4.2

set.seed(123)
split <- initial_split(selected_data, prop = 0.7) # Specify the primary variable for stratification
train_data <- training(split)
test_data <- testing(split)

# fit it into a regression model
full_lm <- lm(Call.Duration.In.Minutes ~ ., data = train_data)
summary(full_lm)

##
## Call:
## lm(formula = Call.Duration.In.Minutes ~ ., data = train_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -26.9216 -10.0453  0.1259   9.9648  26.8692
##
## Coefficients: (24 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    23.45415    4.50828   5.202 1.98e-07 ***
## CityAiken      -6.90192    5.66486  -1.218  0.22309
## CityAkron      -6.19518    4.40203  -1.407  0.15934
## CityAlbany     -8.19703    5.09751  -1.608  0.10784
## CityAlbuquerque  1.32119    4.64524   0.284  0.77609
## CityAlexandria -2.86311    3.47622  -0.824  0.41016
## CityAlhambra   -0.62889    4.69401  -0.134  0.89342
## CityAllentown -10.71695    6.33188  -1.693  0.09056 .
## CityAlpharetta -11.09940    5.76240  -1.926  0.05410 .
## CityAmarillo   -2.91417    2.68044  -1.087  0.27696
## CityAnaheim    -6.18189    3.83030  -1.614  0.10655
## CityAnchorage   0.38223    4.75180   0.080  0.93589
## CityAnderson   -9.25904    4.87694  -1.899  0.05764 .
## CityAnn Arbor   1.70592    6.03089   0.283  0.77728
```

## CityAnnapolis	-1.18229	5.74927	-0.206	0.83707
## CityAnniston	4.55381	5.57592	0.817	0.41411
## CityApache Junction	-9.79163	5.14557	-1.903	0.05706 .
## CityAppleton	2.67135	5.85873	0.456	0.64842
## CityArlington	-3.27344	2.82328	-1.159	0.24629
## CityArvada	0.61007	6.30136	0.097	0.92287
## CityAshburn	1.52426	4.22496	0.361	0.71827
## CityAsheville	3.55381	5.11386	0.695	0.48710
## CityAthens	-9.31132	5.15393	-1.807	0.07083 .
## CityAtlanta	-10.18359	4.43490	-2.296	0.02167 *
## CityAugusta	-7.14757	4.73023	-1.511	0.13079
## CityAurora	-7.53501	4.86912	-1.548	0.12175
## CityAustin	-3.67657	2.55238	-1.440	0.14975
## CityBakersfield	-2.66729	3.64900	-0.731	0.46481
## CityBaltimore	2.90855	4.62186	0.629	0.52916
## CityBaton Rouge	-4.91257	4.61815	-1.064	0.28745
## CityBattle Creek	2.46360	6.03096	0.408	0.68292
## CityBeaufort	-10.25495	5.81007	-1.765	0.07757 .
## CityBeaumont	-2.85006	3.35080	-0.851	0.39502
## CityBeaverton	4.95508	5.44579	0.910	0.36289
## CityBellevue	2.33370	5.34391	0.437	0.66233
## CityBerkeley	-2.09903	3.99048	-0.526	0.59889
## CityBethesda	1.78728	5.07000	0.353	0.72445
## CityBethlehem	-11.48149	6.27864	-1.829	0.06746 .
## CityBillings	1.07696	4.88950	0.220	0.82567
## CityBiloxi	-2.78035	6.43124	-0.432	0.66551
## CityBirmingham	0.73122	4.59187	0.159	0.87348
## CityBismarck	4.23142	5.44559	0.777	0.43715
## CityBloomington	-10.22236	4.53311	-2.255	0.02414 *
## CityBoca Raton	-9.90628	5.85105	-1.693	0.09045 .
## CityBoise	3.43866	4.69305	0.733	0.46374
## CityBonita Springs	-12.60146	6.46205	-1.950	0.05118 .
## CityBoston	-1.47253	4.03783	-0.365	0.71535
## CityBoulder	-7.22479	5.48453	-1.317	0.18775
## CityBowie	5.70128	5.74915	0.992	0.32137
## CityBoynton Beach	-6.25351	6.82288	-0.917	0.35939
## CityBozeman	4.75594	5.74899	0.827	0.40810
## CityBradenton	-6.70366	5.89595	-1.137	0.25555
## CityBrea	-1.40737	4.36351	-0.323	0.74705
## CityBridgeport	2.66232	5.11414	0.521	0.60266
## CityBrockton	-4.93098	4.57157	-1.079	0.28077
## CityBronx	-6.55540	5.35110	-1.225	0.22057
## CityBrooklyn	-9.47408	5.27765	-1.795	0.07265 .
## CityBrooksville	-6.67150	6.46194	-1.032	0.30188
## CityBryan	-2.85367	3.98080	-0.717	0.47347
## CityBuffalo	-8.19755	5.28294	-1.552	0.12075
## CityBurbank	-8.87423	4.13431	-2.146	0.03184 *
## CityCambridge	-9.86909	5.41370	-1.823	0.06832 .
## CityCamden	2.99258	6.81877	0.439	0.66076
## CityCanton	-6.30709	4.58375	-1.376	0.16885
## CityCape Coral	-14.15625	6.34974	-2.229	0.02580 *
## CityCarlsbad	0.23476	4.53848	0.052	0.95875
## CityCarol Stream	-5.00174	4.28628	-1.167	0.24326
## CityCarson City	-0.84808	5.06991	-0.167	0.86715

## CityCedar Rapids	2.50570	5.01488	0.500	0.61732
## CityChampaign	-6.78056	5.58688	-1.214	0.22489
## CityChandler	-4.76204	4.97085	-0.958	0.33808
## CityCharleston	-11.24471	5.03374	-2.234	0.02550 *
## CityCharlotte	1.67311	4.59325	0.364	0.71567
## CityCharlottesville	-8.30879	3.75489	-2.213	0.02692 *
## CityChattanooga	-4.67969	7.04405	-0.664	0.50648
## CityChesapeake	-1.80509	4.05796	-0.445	0.65645
## CityCheyenne	1.51068	6.35096	0.238	0.81199
## CityChicago	-5.48777	3.77933	-1.452	0.14650
## CityChico	-3.67019	5.17909	-0.709	0.47855
## CityChula Vista	-8.35353	5.02638	-1.662	0.09654 .
## CityCincinnati	-6.98328	4.23603	-1.649	0.09926 .
## CityClearwater	-11.07680	5.72667	-1.934	0.05310 .
## CityCleveland	-6.35767	4.29942	-1.479	0.13923
## CityCollege Station	-3.06227	3.82034	-0.802	0.42281
## CityColorado Springs	-8.15172	5.28648	-1.542	0.12309
## CityColumbia	-6.19522	4.60219	-1.346	0.17827
## CityColumbus	-7.66365	4.22416	-1.814	0.06965 .
## CityConcord	-8.34045	4.89814	-1.703	0.08862 .
## CityConroe	-6.10988	3.98104	-1.535	0.12486
## CityCorona	-0.87695	4.19818	-0.209	0.83454
## CityCorpus Christi	-5.12762	2.73601	-1.874	0.06093 .
## CityCrawfordsville	-5.64736	6.18698	-0.913	0.36137
## CityCumming	-5.38459	5.89544	-0.913	0.36107
## CityDallas	-4.49833	2.50713	-1.794	0.07279 .
## CityDanbury	6.01603	5.57650	1.079	0.28068
## CityDavenport	-0.41244	4.89937	-0.084	0.93291
## CityDayton	-5.43384	4.29673	-1.265	0.20601
## CityDaytona Beach	-9.56234	5.88741	-1.624	0.10435
## CityDearborn	0.10677	5.73265	0.019	0.98514
## CityDecatur	-9.44258	4.32281	-2.184	0.02895 *
## CityDelray Beach	-12.39275	6.30392	-1.966	0.04932 *
## CityDenton	-8.36876	3.41728	-2.449	0.01433 *
## CityDenver	-8.04447	5.26861	-1.527	0.12681
## CityDes Moines	2.00898	4.60403	0.436	0.66259
## CityDetroit	-4.14364	4.44940	-0.931	0.35172
## CityDulles	-1.87908	4.55766	-0.412	0.68013
## CityDuluth	-9.93562	4.88634	-2.033	0.04203 *
## CityDurham	1.34763	4.82692	0.279	0.78010
## CityEast Saint Louis	-4.79632	4.59145	-1.045	0.29621
## CityEdmond	7.47243	5.85957	1.275	0.20223
## CityEl Paso	-4.82862	2.49347	-1.937	0.05282 .
## CityElizabeth	5.62482	7.26130	0.775	0.43857
## CityElmira	-11.66426	5.85377	-1.993	0.04632 *
## CityEnglewood	-5.82176	6.85430	-0.849	0.39569
## CityErie	-14.21308	5.64841	-2.516	0.01187 *
## CityEscondido	-5.36003	4.36346	-1.228	0.21931
## CityEugene	4.57442	6.95265	0.658	0.51058
## CityEvanston	-3.50387	5.14257	-0.681	0.49566
## CityEvansville	-9.14680	4.72761	-1.935	0.05303 .
## CityEverett	-0.30340	5.74961	-0.053	0.95792
## CityFairbanks	-4.65242	5.13909	-0.905	0.36532
## CityFairfax	-5.67783	4.05815	-1.399	0.16179

## CityFairfield	4.86445	5.85890	0.830	0.40640
## CityFalls Church	-3.52367	4.37055	-0.806	0.42012
## CityFargo	0.85276	5.13913	0.166	0.86821
## CityFarmington	-7.65889	5.62004	-1.363	0.17296
## CityFayetteville	8.59169	5.34379	1.608	0.10790
## CityFlint	-5.23450	4.69391	-1.115	0.26479
## CityFlorence	-6.32813	5.73242	-1.104	0.26964
## CityFlushing	-9.38369	5.56787	-1.685	0.09194 .
## CityFort Collins	-4.84538	6.30205	-0.769	0.44199
## CityFort Lauderdale	-9.02959	5.67781	-1.590	0.11177
## CityFort Myers	-9.29188	5.90492	-1.574	0.11560
## CityFort Pierce	-9.18478	6.11118	-1.503	0.13287
## CityFort Smith	2.03033	5.06984	0.400	0.68881
## CityFort Wayne	-8.52498	4.70140	-1.813	0.06980 .
## CityFort Worth	-3.77873	2.61501	-1.445	0.14847
## CityFrankfort	2.91199	5.85896	0.497	0.61918
## CityFrederick	-1.85433	5.74962	-0.323	0.74707
## CityFredericksburg	-4.64369	4.10815	-1.130	0.25834
## CityFresno	-3.82156	3.48931	-1.095	0.27343
## CityFullerton	-5.77013	4.23395	-1.363	0.17295
## CityGadsden	3.03972	5.74930	0.529	0.59701
## CityGainesville	-7.83565	5.19361	-1.509	0.13139
## CityGaithersburg	1.66626	6.15067	0.271	0.78647
## CityGalveston	-7.72281	3.75241	-2.058	0.03959 *
## CityGarden Grove	-3.12819	3.99067	-0.784	0.43312
## CityGarland	-0.14148	3.82045	-0.037	0.97046
## CityGary	-11.13955	5.34298	-2.085	0.03709 *
## CityGastonia	3.44545	6.15056	0.560	0.57536
## CityGatesville	-1.02496	4.18546	-0.245	0.80655
## CityGilbert	-8.47685	5.30500	-1.598	0.11008
## CityGlendale	-3.29057	3.84736	-0.855	0.39241
## CityGrand Forks	-0.48781	5.30070	-0.092	0.92668
## CityGrand Junction	-4.01117	5.97695	-0.671	0.50216
## CityGrand Rapids	-5.80630	4.61126	-1.259	0.20799
## CityGreat Neck	-4.79214	6.48463	-0.739	0.45991
## CityGreeley	-9.74679	6.40117	-1.523	0.12786
## CityGreen Bay	4.15008	5.05012	0.822	0.41121
## CityGreensboro	-1.25314	4.69981	-0.267	0.78975
## CityGreenville	-12.38873	5.36256	-2.310	0.02088 *
## CityGulfport	-2.80437	6.79347	-0.413	0.67975
## CityHagerstown	0.83634	5.65609	0.148	0.88245
## CityHamilton	-3.57285	5.47388	-0.653	0.51395
## CityHampton	-4.85153	4.10854	-1.181	0.23768
## CityHarrisburg	-10.92860	5.73482	-1.906	0.05671 .
## CityHartford	2.63859	4.67501	0.564	0.57248
## CityHattiesburg	-2.29017	6.23101	-0.368	0.71322
## CityHayward	3.14803	4.78887	0.657	0.51095
## CityHelena	9.50246	5.85876	1.622	0.10483
## CityHenderson	5.06132	5.50665	0.919	0.35804
## CityHerndon	-5.77677	4.29357	-1.345	0.17849
## CityHialeah	-10.59121	6.30319	-1.680	0.09291 .
## CityHicksville	-8.80183	5.93625	-1.483	0.13816
## CityHigh Point	-4.86452	6.95318	-0.700	0.48418
## CityHollywood	-8.57596	6.03028	-1.422	0.15500

## CityHomestead	-11.03104	7.37080	-1.497	0.13451
## CityHonolulu	2.62826	4.65031	0.565	0.57196
## CityHot Springs National Park	8.74556	5.34385	1.637	0.10174
## CityHouston	-3.93788	2.47823	-1.589	0.11208
## CityHumble	-2.27291	4.07628	-0.558	0.57713
## CityHuntington	-10.35633	5.32798	-1.944	0.05194 .
## CityHuntington Beach	-2.89800	4.31624	-0.671	0.50196
## CityHuntsville	3.18863	4.18491	0.762	0.44611
## CityHyattsville	3.25340	5.44620	0.597	0.55027
## CityIdaho Falls	2.92087	5.39209	0.542	0.58803
## CityIndependence	-9.58103	5.01985	-1.909	0.05632 .
## CityIndianapolis	-8.90410	4.66031	-1.911	0.05607 .
## CityInglewood	-8.28833	3.81970	-2.170	0.03003 *
## CityIowa City	1.01703	5.57622	0.182	0.85528
## CityIrvine	-1.17080	3.74921	-0.312	0.75483
## CityIrving	-7.67232	3.24180	-2.367	0.01796 *
## CityJackson	-3.90116	5.72750	-0.681	0.49580
## CityJacksonville	-9.81876	5.65671	-1.736	0.08262 .
## CityJamaica	-7.81265	5.30169	-1.474	0.14060
## CityJefferson City	-3.94672	4.63092	-0.852	0.39408
## CityJeffersonville	-6.03924	5.89627	-1.024	0.30573
## CityJersey City	4.35778	6.67309	0.653	0.51374
## CityJohnson City	-1.94620	7.45470	-0.261	0.79404
## CityJohnstown	-8.16398	7.07805	-1.153	0.24875
## CityJoliet	-3.92313	4.68463	-0.837	0.40235
## CityJuneau	0.73642	5.85894	0.126	0.89998
## CityKalamazoo	4.77166	4.96921	0.960	0.33694
## CityKansas City	-5.43894	4.14433	-1.312	0.18940
## CityKaty	0.84468	4.07614	0.207	0.83584
## CityKent	1.38474	5.57648	0.248	0.80389
## CityKilleen	-3.10488	4.62663	-0.671	0.50217
## CityKingsport	-11.04056	8.37638	-1.318	0.18750
## CityKissimmee	-16.54927	6.82273	-2.426	0.01529 *
## CityKnoxville	-3.76734	6.97211	-0.540	0.58897
## CityLafayette	-7.55181	4.68342	-1.612	0.10688
## CityLake Charles	-4.34857	5.20291	-0.836	0.40328
## CityLake Worth	-8.26050	5.97038	-1.384	0.16650
## CityLakeland	-11.45354	5.97061	-1.918	0.05508 .
## CityLakewood	3.59075	5.74928	0.625	0.53227
## CityLancaster	-6.28589	4.89822	-1.283	0.19940
## CityLansing	-3.15795	4.59469	-0.687	0.49190
## CityLaredo	-4.37375	4.31035	-1.015	0.31026
## CityLargo	-8.85987	6.04818	-1.465	0.14297
## CityLas Cruces	-3.14803	5.65612	-0.557	0.57783
## CityLas Vegas	1.86376	4.59533	0.406	0.68506
## CityLaurel	-6.70618	5.74939	-1.166	0.24346
## CityLawrenceville	-11.12298	4.82794	-2.304	0.02124 *
## CityLees Summit	-4.38300	5.30244	-0.827	0.40847
## CityLehigh Acres	-10.05858	6.82270	-1.474	0.14042
## CityLevittown	-7.80993	6.46230	-1.209	0.22685
## CityLexington	2.77600	4.66958	0.594	0.55219
## CityLima	-11.61864	5.37595	-2.161	0.03069 *
## CityLincoln	4.15534	4.74384	0.876	0.38107
## CityLittle Rock	-0.24945	4.70484	-0.053	0.95772

## CityLittleton	-8.76807	5.56523	-1.576	0.11515
## CityLondon	0.36926	5.19493	0.071	0.94333
## CityLong Beach	-1.94482	3.68112	-0.528	0.59728
## CityLongview	-0.49962	4.07681	-0.123	0.90246
## CityLoretto	-7.15179	6.15978	-1.161	0.24564
## CityLos Angeles	-3.61144	3.44912	-1.047	0.29508
## CityLouisville	2.04876	4.60642	0.445	0.65650
## CityLubbock	-1.88673	2.95943	-0.638	0.52379
## CityLynchburg	1.47689	3.93210	0.376	0.70722
## CityLynn	-9.38787	5.55558	-1.690	0.09108 .
## CityMacon	-8.38118	4.74641	-1.766	0.07744 .
## CityMadison	2.04018	4.68444	0.436	0.66319
## CityManassas	-10.09792	4.80682	-2.101	0.03567 *
## CityManchester	-6.82108	5.96842	-1.143	0.25311
## CityMansfield	-4.22185	5.00099	-0.844	0.39857
## CityMaple Plain	-15.08323	5.84567	-2.580	0.00988 **
## CityMarietta	-11.08736	5.11838	-2.166	0.03031 *
## CityMc Keesport	-11.96583	6.46191	-1.852	0.06408 .
## CityMelbourne	-8.20401	6.19291	-1.325	0.18527
## CityMemphis	-2.85952	6.90165	-0.414	0.67864
## CityMeridian	1.33955	6.31850	0.212	0.83211
## CityMerrifield	-0.47790	4.55747	-0.105	0.91649
## CityMesa	-6.84257	4.39628	-1.556	0.11962
## CityMesquite	-7.73069	5.40331	-1.431	0.15252
## CityMetairie	-2.94609	5.32063	-0.554	0.57978
## CityMiami	-10.23055	5.61377	-1.822	0.06841 .
## CityMiami Beach	-11.99187	6.46152	-1.856	0.06348 .
## CityMidland	-2.74814	3.33557	-0.824	0.41001
## CityMigrate	-5.21553	6.60870	-0.789	0.43001
## CityMilwaukee	2.70476	4.67311	0.579	0.56273
## CityMinneapolis	-10.68056	5.28634	-2.020	0.04335 *
## CityMissoula	-1.81539	5.86014	-0.310	0.75673
## CityMobile	2.68206	4.62984	0.579	0.56239
## CityModesto	-6.92039	4.16487	-1.662	0.09661 .
## CityMonroe	-3.73911	5.23827	-0.714	0.47535
## CityMontgomery	1.15588	4.64653	0.249	0.80355
## CityMonticello	-12.28205	5.54640	-2.214	0.02681 *
## CityMontpelier	-0.18799	5.85883	-0.032	0.97440
## CityMoreno Valley	-5.38255	4.47385	-1.203	0.22894
## CityMorgantown	-11.70477	5.95453	-1.966	0.04935 *
## CityMount Vernon	-8.71468	6.10394	-1.428	0.15339
## CityMountain View	1.31341	4.36315	0.301	0.76340
## CityMuncie	-3.32008	5.78780	-0.574	0.56622
## CityMurfreesboro	-5.44345	8.02051	-0.679	0.49734
## CityMuskegon	-2.15247	5.73254	-0.375	0.70731
## CityMyrtle Beach	-5.90442	6.74026	-0.876	0.38104
## CityNaperville	-9.69161	4.86954	-1.990	0.04658 *
## CityNaples	-12.58339	5.78228	-2.176	0.02955 *
## CityNashville	-6.20238	6.93064	-0.895	0.37084
## CityNew Bedford	-3.74132	5.72815	-0.653	0.51367
## CityNew Brunswick	-0.38743	6.86778	-0.056	0.95501
## CityNew Castle	-17.24734	6.54420	-2.636	0.00841 **
## CityNew Haven	2.83892	4.79696	0.592	0.55398
## CityNew Hyde Park	0.64621	6.26282	0.103	0.91782

## CityNew Orleans	-4.45166	4.57267	-0.974	0.33030
## CityNew York City	-8.51231	5.18242	-1.643	0.10049
## CityNewark	9.10796	5.86114	1.554	0.12021
## CityNewport Beach	-5.37184	4.89850	-1.097	0.27282
## CityNewport News	-6.78532	3.80565	-1.783	0.07461 .
## CityNewton	-4.45494	4.54814	-0.980	0.32734
## CityNorcross	-11.55322	5.19403	-2.224	0.02614 *
## CityNorfolk	-2.93344	3.44895	-0.851	0.39504
## CityNorman	1.87912	5.85916	0.321	0.74843
## CityNorth Hollywood	-0.18264	4.27312	-0.043	0.96591
## CityNorth Las Vegas	2.11422	5.16590	0.409	0.68235
## CityNorth Little Rock	4.41786	5.13897	0.860	0.38998
## CityNorth Port	-3.93157	6.40180	-0.614	0.53913
## CityNorthridge	-3.12183	4.47344	-0.698	0.48527
## CityNorwalk	-3.52880	5.44580	-0.648	0.51700
## CityOakland	-6.16385	3.60929	-1.708	0.08769 .
## CityOcala	-15.45193	6.04842	-2.555	0.01063 *
## CityOceanside	-6.45512	4.53846	-1.422	0.15495
## CityOdessa	-1.80453	3.17546	-0.568	0.56986
## CityOgden	0.89750	5.11412	0.175	0.86069
## CityOklahoma City	1.49503	4.58553	0.326	0.74440
## CityOlympia	-2.20599	5.07032	-0.435	0.66351
## CityOmaha	0.03104	4.65882	0.007	0.99468
## CityOrange	-4.73328	3.74177	-1.265	0.20589
## CityOrlando	-10.89861	5.64616	-1.930	0.05359 .
## CityOxnard	-5.76551	5.59185	-1.031	0.30253
## CityPalatine	-4.36226	4.86953	-0.896	0.37035
## CityPalm Bay	-7.80217	6.61167	-1.180	0.23799
## CityPalmdale	3.50919	5.02656	0.698	0.48510
## CityPalo Alto	-2.16891	4.41544	-0.491	0.62328
## CityPanama City	-4.33323	6.26266	-0.692	0.48900
## CityPasadena	-4.26300	3.32699	-1.281	0.20009
## CityPaterson	5.89645	6.36978	0.926	0.35462
## CityPensacola	-10.22542	5.71528	-1.789	0.07361 .
## CityPeoria	-4.42536	3.81287	-1.161	0.24580
## CityPetaluma	-8.05511	5.36364	-1.502	0.13316
## CityPhiladelphia	-12.19726	5.55399	-2.196	0.02809 *
## CityPhoenix	-1.51982	4.13952	-0.367	0.71351
## CityPinellas Park	-10.82399	6.22568	-1.739	0.08212 .
## CityPittsburgh	-11.53519	5.54716	-2.079	0.03758 *
## CityPlano	-4.95735	4.31008	-1.150	0.25008
## CityPocatello	2.28828	5.39181	0.424	0.67128
## CityPomona	-1.86406	5.02674	-0.371	0.71077
## CityPompano Beach	-8.77624	6.11107	-1.436	0.15098
## CityPort Charlotte	-10.61563	6.61139	-1.606	0.10836
## CityPort Saint Lucie	-5.07510	6.34974	-0.799	0.42415
## CityPort Washington	-9.04047	5.93604	-1.523	0.12778
## CityPortland	0.94028	4.62178	0.203	0.83879
## CityPortsmouth	-9.16460	4.55750	-2.011	0.04435 *
## CityPrescott	-3.50657	5.14605	-0.681	0.49562
## CityProvidence	4.58276	5.09110	0.900	0.36805
## CityProvo	-4.33910	5.44591	-0.797	0.42560
## CityPueblo	-6.86465	5.50483	-1.247	0.21240
## CityPunta Gorda	-3.21809	6.40180	-0.503	0.61519

## CityRacine	-2.72952	5.74939	-0.475	0.63497
## CityRaleigh	1.42556	4.65573	0.306	0.75946
## CityReading	-13.90999	5.97416	-2.328	0.01990 *
## CityRedwood City	-1.83471	4.47372	-0.410	0.68173
## CityReno	1.13897	4.75155	0.240	0.81056
## CityReston	0.18523	4.01218	0.046	0.96318
## CityRichmond	-2.67638	3.10547	-0.862	0.38879
## CityRidgely	15.25269	7.44026	2.050	0.04037 *
## CityRiverside	-6.00790	3.86533	-1.554	0.12013
## CityRoanoke	-4.14330	3.20178	-1.294	0.19566
## CityRochester	-8.86107	5.18537	-1.709	0.08749 .
## CityRockford	-3.53329	4.23629	-0.834	0.40426
## CityRockville	-0.39814	5.85884	-0.068	0.94582
## CityRound Rock	2.19783	3.89603	0.564	0.57268
## CitySacramento	-3.23770	3.44430	-0.940	0.34722
## CitySaginaw	-7.09541	5.12240	-1.385	0.16601
## CitySaint Augustine	-8.93784	6.61190	-1.352	0.17646
## CitySaint Cloud	-13.23879	5.68779	-2.328	0.01994 *
## CitySaint Joseph	-3.03387	5.14367	-0.590	0.55531
## CitySaint Louis	-5.05421	4.15946	-1.215	0.22434
## CitySaint Paul	-10.91871	5.31416	-2.055	0.03992 *
## CitySaint Petersburg	-8.58497	5.69930	-1.506	0.13200
## CitySalem	-1.87224	5.05018	-0.371	0.71084
## CitySalinas	-0.93267	4.69385	-0.199	0.84250
## CitySalt Lake City	0.15085	4.60354	0.033	0.97386
## CitySan Angelo	1.55594	4.18555	0.372	0.71009
## CitySan Antonio	-4.85707	2.55765	-1.899	0.05757 .
## CitySan Bernardino	-2.23577	3.76504	-0.594	0.55263
## CitySan Diego	-5.41307	3.46941	-1.560	0.11872
## CitySan Francisco	-3.79447	3.47007	-1.093	0.27419
## CitySan Jose	-5.02837	3.51913	-1.429	0.15306
## CitySan Luis Obispo	-8.53601	4.31607	-1.978	0.04797 *
## CitySan Mateo	-9.51701	4.47339	-2.127	0.03339 *
## CitySan Rafael	-6.04090	5.02691	-1.202	0.22949
## CitySandy	-0.10745	6.15077	-0.017	0.98606
## CitySanta Ana	-5.46356	4.23416	-1.290	0.19694
## CitySanta Barbara	-2.78179	3.87834	-0.717	0.47322
## CitySanta Clara	-4.63736	4.69398	-0.988	0.32319
## CitySanta Cruz	0.91176	5.02693	0.181	0.85608
## CitySanta Fe	4.69286	5.34383	0.878	0.37985
## CitySanta Monica	-2.52270	4.31609	-0.584	0.55890
## CitySanta Rosa	-1.04070	4.69375	-0.222	0.82453
## CitySarasota	-7.37813	5.87963	-1.255	0.20954
## CitySavannah	-7.89515	4.67238	-1.690	0.09109 .
## CitySchaumburg	-6.36462	5.03782	-1.263	0.20647
## CitySchenectady	-12.40343	5.64518	-2.197	0.02802 *
## CityScottsdale	-3.72420	4.45950	-0.835	0.40366
## CityScranton	-13.12487	6.15379	-2.133	0.03295 *
## CitySeattle	0.98482	4.59227	0.214	0.83020
## CitySeminole	-8.63383	6.26276	-1.379	0.16803
## CityShawnee Mission	-3.60612	4.79851	-0.752	0.45236
## CityShreveport	-5.43701	4.67062	-1.164	0.24440
## CitySilver Spring	2.89384	4.95603	0.584	0.55929
## CitySimi Valley	-8.72237	4.89803	-1.781	0.07496 .

## CitySioux City	5.56065	5.16547	1.077	0.28171	
## CitySioux Falls	2.54964	4.73049	0.539	0.58991	
## CitySouth Bend	-9.75312	4.81395	-2.026	0.04278	*
## CitySouth Lake Tahoe	-1.66508	5.02643	-0.331	0.74045	
## CitySouthfield	-9.00110	5.73285	-1.570	0.11641	
## CitySparks	1.41683	5.30100	0.267	0.78926	
## CitySpartanburg	-6.76561	5.15752	-1.312	0.18960	
## CitySpokane	2.21184	4.69308	0.471	0.63743	
## CitySpring	-2.24209	3.53685	-0.634	0.52614	
## CitySpring Hill	-2.83688	6.22580	-0.456	0.64863	
## CitySpringfield	-4.85504	3.61538	-1.343	0.17932	
## CityStamford	1.88651	4.90975	0.384	0.70081	
## CityStaten Island	-6.82721	5.53187	-1.234	0.21716	
## CitySterling	-5.53166	4.96607	-1.114	0.26534	
## CityStockton	-1.35623	3.73481	-0.363	0.71651	
## CitySuffolk	-2.37137	4.37044	-0.543	0.58741	
## CitySunnyvale	-7.51651	4.47350	-1.680	0.09293	.
## CitySyracuse	-6.80264	5.37936	-1.265	0.20603	
## CityTacoma	1.50732	4.69320	0.321	0.74808	
## CityTallahassee	-8.23180	5.78999	-1.422	0.15512	
## CityTampa	-10.40783	5.64665	-1.843	0.06531	.
## CityTempe	-3.92050	5.08092	-0.772	0.44035	
## CityTemple	-1.56905	4.30988	-0.364	0.71582	
## CityTerre Haute	-12.37230	5.18181	-2.388	0.01697	*
## CityTexarkana	1.52212	4.62708	0.329	0.74219	
## CityToledo	-7.39993	4.34388	-1.704	0.08848	.
## CityTopeka	-5.06800	4.74069	-1.069	0.28506	
## CityTorrance	-5.41288	4.31642	-1.254	0.20985	
## CityTrenton	5.99709	6.25303	0.959	0.33753	
## CityTroy	-13.56038	5.73239	-2.366	0.01801	*
## CityTucson	-3.96859	4.20554	-0.944	0.34535	
## CityTulsa	0.81047	4.60283	0.176	0.86023	
## CityTuscaloosa	0.45221	5.30081	0.085	0.93202	
## CityTyler	-2.63870	2.89573	-0.911	0.36218	
## CityUtica	-13.96615	6.63280	-2.106	0.03525	*
## CityValdosta	-8.31165	5.65055	-1.471	0.14132	
## CityValley Forge	-11.40994	6.54421	-1.744	0.08126	.
## CityVan Nuys	-5.21869	3.79983	-1.373	0.16964	
## CityVancouver	1.36357	4.99893	0.273	0.78503	
## CityVentura	-6.48898	4.53815	-1.430	0.15277	
## CityVero Beach	-11.08833	5.99820	-1.849	0.06453	.
## CityVienna	-5.88846	4.29397	-1.371	0.17028	
## CityVirginia Beach	-3.70189	3.47474	-1.065	0.28672	
## CityVisalia	-0.51124	4.53806	-0.113	0.91030	
## CityWaco	-5.73972	3.13687	-1.830	0.06730	.
## CityWaltham	-3.12169	5.10629	-0.611	0.54098	
## CityWarren	-6.39575	4.59949	-1.391	0.16438	
## CityWashington	1.62551	4.52777	0.359	0.71959	
## CityWaterbury	1.18069	4.88991	0.241	0.80921	
## CityWaterloo	5.70160	5.57664	1.022	0.30660	
## CityWatertown	-1.77471	5.19353	-0.342	0.73257	
## CityWest Hartford	3.71743	5.85899	0.634	0.52577	
## CityWest Palm Beach	-8.86450	5.75038	-1.542	0.12320	
## CityWhite Plains	-6.35428	5.61119	-1.132	0.25747	

## CityWhittier	-5.11494	4.47341	-1.143	0.25288
## CityWichita	-1.94741	4.78232	-0.407	0.68386
## CityWichita Falls	-6.26748	3.26640	-1.919	0.05503 .
## CityWilkes Barre	-14.24678	5.76797	-2.470	0.01352 *
## CityWilmington	4.57603	5.09100	0.899	0.36874
## CityWinston Salem	0.25906	4.82031	0.054	0.95714
## CityWinter Haven	-6.09380	6.46156	-0.943	0.34565
## CityWoburn	-2.56924	5.19375	-0.495	0.62083
## CityWorcester	-3.73034	4.46873	-0.835	0.40386
## CityYakima	1.09361	5.65614	0.193	0.84669
## CityYonkers	-13.96312	7.38297	-1.891	0.05860 .
## CityYork	-13.18934	6.33174	-2.083	0.03726 *
## CityYoung America	-13.12803	5.52270	-2.377	0.01746 *
## CityYoungstown	-8.07767	4.67882	-1.726	0.08428 .
## CityZephyrhills	-3.38310	6.70715	-0.504	0.61398
## SentimentNeutral	-0.24635	0.20509	-1.201	0.22970
## SentimentPositive	-0.32509	0.26493	-1.227	0.21980
## SentimentVery Negative	-0.31359	0.22822	-1.374	0.16944
## SentimentVery Positive	-0.27808	0.28919	-0.962	0.33627
## StateAlaska	NA	NA	NA	NA
## StateArizona	4.42361	5.01132	0.883	0.37739
## StateArkansas	NA	NA	NA	NA
## StateCalifornia	5.73121	4.46050	1.285	0.19885
## StateColorado	8.22596	5.96737	1.378	0.16807
## StateConnecticut	NA	NA	NA	NA
## StateDelaware	-2.16133	2.86343	-0.755	0.45037
## StateDistrict of Columbia	NA	NA	NA	NA
## StateFlorida	11.36304	6.29431	1.805	0.07104 .
## StateGeorgia	10.92368	5.27535	2.071	0.03840 *
## StateHawaii	NA	NA	NA	NA
## StateIdaho	NA	NA	NA	NA
## StateIllinois	8.08002	4.72698	1.709	0.08740 .
## StateIndiana	10.68999	5.42196	1.972	0.04867 *
## StateIowa	NA	NA	NA	NA
## StateKansas	6.09863	5.47167	1.115	0.26504
## StateKentucky	NA	NA	NA	NA
## StateLouisiana	6.36216	5.35789	1.187	0.23507
## StateMaine	-0.89351	3.71256	-0.241	0.80981
## StateMaryland	NA	NA	NA	NA
## StateMassachusetts	5.07923	4.89275	1.038	0.29923
## StateMichigan	6.33955	5.24362	1.209	0.22667
## StateMinnesota	13.92160	5.98398	2.326	0.02000 *
## StateMississippi	3.51241	6.26272	0.561	0.57491
## StateMissouri	6.09960	5.00825	1.218	0.22327
## StateMontana	NA	NA	NA	NA
## StateNebraska	NA	NA	NA	NA
## StateNevada	NA	NA	NA	NA
## StateNew Hampshire	7.11865	5.95840	1.195	0.23221
## StateNew Jersey	-5.16673	4.10395	-1.259	0.20806
## StateNew Mexico	NA	NA	NA	NA
## StateNew York	10.24344	5.92633	1.728	0.08392 .
## StateNorth Carolina	NA	NA	NA	NA
## StateNorth Dakota	NA	NA	NA	NA
## StateOhio	8.53010	5.08565	1.677	0.09350 .

```
## StateOklahoma          NA          NA          NA          NA
## StateOregon             NA          NA          NA          NA
## StatePennsylvania      14.38483    6.22309    2.312    0.02081 *
## StateRhode Island      NA          NA          NA          NA
## StateSouth Carolina    9.17773    5.54288    1.656    0.09778 .
## StateSouth Dakota      NA          NA          NA          NA
## StateTennessee         5.88354    7.44677    0.790    0.42949
## StateTexas             5.86128    3.80521    1.540    0.12349
## StateUtah              NA          NA          NA          NA
## StateVermont            NA          NA          NA          NA
## StateVirginia          5.03862    4.21131    1.196    0.23153
## StateWashington        NA          NA          NA          NA
## StateWest Virginia     13.49948    5.94482    2.271    0.02317 *
## StateWisconsin         NA          NA          NA          NA
## StateWyoming           NA          NA          NA          NA
## ReasonPayments         0.34708    0.22672    1.531    0.12581
## ReasonService Outage   0.04469    0.22705    0.197    0.84396
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 11.84 on 22565 degrees of freedom
## Multiple R-squared:  0.02334,    Adjusted R-squared:  0.00204
## F-statistic: 1.096 on 492 and 22565 DF,  p-value: 0.07201
```

```
### full model is doing terrible at predicting duration
### lets try step selection regression
step_lm <- step(full_lm,train_data,direction = "both")
```

```
## Start:  AIC=114447.3
## Call:Duration.In.Minutes ~ City + Sentiment + State + Reason
##
##           Df Sum of Sq    RSS    AIC
## - City      436      67546 3228731 114063
## - State      26       3545 3164730 114421
## - Sentiment   4        422 3161607 114442
## - Reason      2        329 3161514 114446
## <none>                3161185 114447
##
## Step:  AIC=114062.8
## Call:Duration.In.Minutes ~ Sentiment + State + Reason
##
##           Df Sum of Sq    RSS    AIC
## - State     50      7171.1 3235902 114014
## - Sentiment  4       460.9 3229192 114058
## - Reason     2       336.2 3229067 114061
## <none>                3228731 114063
##
## Step:  AIC=114013.9
## Call:Duration.In.Minutes ~ Sentiment + Reason
##
##           Df Sum of Sq    RSS    AIC
## - Sentiment  4       466.56 3236368 114009
## - Reason      2       348.67 3236251 114012
## <none>                3235902 114014
```

```
##
## Step: AIC=114009.2
## Call.Duration.In.Minutes ~ Reason
##
##           Df Sum of Sq      RSS      AIC
## - Reason   2    345.38 3236714 114008
## <none>                3236368 114009
##
## Step: AIC=114007.7
## Call.Duration.In.Minutes ~ 1
```

```
summary(step_lm)
```

```
##
## Call:
## lm(formula = Call.Duration.In.Minutes ~ 1, data = train_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.054 -10.054  -0.054   9.946  19.946
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 25.05399    0.07803   321.1  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 11.85 on 23057 degrees of freedom
```

model is not improving our chance of predicting duration time of the service correctly.
 ### i think we will get better results if we include ONLY call services of the channel column (because

```
# Make sure dplyr is loaded
library(dplyr)
```

```
# Filter rows where Channel is "Call-Center"
data_call_center <- filter(data, Channel == "Call-Center")
data_call_center <- subset(data_call_center, select = -Channel)
```

```
summary(data_call_center)
```

```
##           Id           Call.Timestamp      Call.Centres.City      City
## Length:10639 Length:10639 Baltimore :3501 Washington : 375
## Class :character Class :character Chicago :1780 Houston : 217
## Mode :character Mode :character Denver : 898 New York City: 189
##                               Los Angeles:4460 El Paso : 163
##                               Dallas : 137
##                               Atlanta : 131
##                               (Other) :9427
## Customer.Name      Reason      Response.Time
## Length:10639 Billing Question:5890 Length:10639
## Class :character Payments :4749 Class :character
## Mode :character Service Outage : 0 Mode :character
```

```
##
##
##
##
##      Sentiment                State      Call.Duration.In.Minutes
## Negative      :3570      Texas          :1137      Min.       : 5.00
## Neutral       :2785      California      :1092      1st Qu.:15.00
## Positive      :1245      Florida         : 923      Median   :25.00
## Very Negative:1983      New York         : 580      Mean     :25.05
## Very Positive:1056      Virginia        : 384      3rd Qu.:35.00
##              District of Columbia: 375      Max.     :45.00
##              (Other)           :6148
##      Csat.Score
## Min.       : 1.000
## 1st Qu.: 4.000
## Median   : 6.000
## Mean     : 5.613
## 3rd Qu.: 8.000
## Max.     :10.000
## NA's      :6672
```

now lets repeat the steps and see correlation between variables using only this call center data

```
# calculate the correlation between Call.Duration.In.Minutes and other numeric variables
numeric_columns <- sapply(data_call_center, is.numeric) # Identify numeric columns
correlations <- cor(data_call_center[, numeric_columns], use = "complete.obs") # Correlation matrix

# extract correlation with Call.Duration.In.Minutes
cor_with_duration <- correlations["Call.Duration.In.Minutes", ]
print(cor_with_duration)
```

```
## Call.Duration.In.Minutes      Csat.Score
##              1.00000000      -0.01274383
```

```
# perform ANOVA for each categorical variable
categorical_columns <- sapply(data_call_center, is.factor) # Identify categorical columns
aov_results <- lapply(data_call_center[, categorical_columns], function(x) {
  aov(Call.Duration.In.Minutes ~ x, data = data_call_center)
})

# view ANOVA results for each categorical variable
aov_summary <- lapply(aov_results, summary)
print(aov_summary)
```

```
## $Call.Centres.City
##              Df Sum Sq Mean Sq F value Pr(>F)
## x              3    155   51.72   0.371  0.774
## Residuals    10635 1484269  139.56
##
## $City
##              Df Sum Sq Mean Sq F value Pr(>F)
## x            460   73444   159.7   1.152 0.0153 *
## Residuals    10178 1410981   138.6
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## $Reason
##           Df Sum Sq Mean Sq F value Pr(>F)
## x           1    189   189.5    1.358  0.244
## Residuals 10637 1484235   139.5
##
## $Sentiment
##           Df Sum Sq Mean Sq F value Pr(>F)
## x           4    988   247.0    1.771  0.132
## Residuals 10634 1483436   139.5
##
## $State
##           Df Sum Sq Mean Sq F value Pr(>F)
## x          50   9740   194.8    1.399 0.0332 *
## Residuals 10588 1474684   139.3
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

results show that there are variables with significant effect on duration: (from highest correlation)

now lets repeat the steps and fit the data to regression models just this time with only call center

```
library(dplyr)
```

```
# Select the columns you want to keep
selected_data <- select(data_call_center, Call.Duration.In.Minutes, City, Sentiment, State, Reason)

# install.packages("caret")
library(rsample)

# split the data to test and train
set.seed(123)
split <- initial_split(selected_data, prop = 0.7) # Specify the primary variable for stratification
train_data <- training(split)
test_data <- testing(split)

# fit the call center data to regression model
full_lm <- lm(Call.Duration.In.Minutes ~ ., data = train_data)
summary(full_lm)
```

```
##
## Call:
## lm(formula = Call.Duration.In.Minutes ~ ., data = train_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -27.905  -9.447   0.097   9.435  27.730
##
## Coefficients: (24 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   18.47907     7.21825   2.560  0.01049 *
## CityAiken      1.42542     9.97453   0.143  0.88637
## CityAkron     -3.00637     8.28898  -0.363  0.71684
## CityAlbany    -8.94782     9.39119  -0.953  0.34073
```


## CityAlbuquerque	5.82804	7.44432	0.783	0.43372
## CityAlexandria	-3.59530	6.80244	-0.529	0.59715
## CityAlhambra	-5.52181	8.23142	-0.671	0.50236
## CityAllentown	-19.18086	10.30925	-1.861	0.06285 .
## CityAlpharetta	-2.25347	10.25082	-0.220	0.82601
## CityAmarillo	1.28508	4.70087	0.273	0.78458
## CityAnaheim	-12.61222	7.87058	-1.602	0.10910
## CityAnchorage	7.15528	7.63923	0.937	0.34897
## CityAnderson	-2.77983	8.93801	-0.311	0.75580
## CityAnn Arbor	10.75322	9.52945	1.128	0.25918
## CityAnnapolis	12.85820	11.03714	1.165	0.24406
## CityAnniston	10.77310	8.94021	1.205	0.22824
## CityApache Junction	-12.58172	9.39956	-1.339	0.18076
## CityAppleton	12.53370	9.32262	1.344	0.17885
## CityArlington	-1.61462	4.80421	-0.336	0.73682
## CityArvada	6.77553	10.95035	0.619	0.53610
## CityAshburn	6.30672	7.40769	0.851	0.39459
## CityAsheville	7.81107	8.33396	0.937	0.34866
## CityAthens	-12.40568	9.25624	-1.340	0.18021
## CityAtlanta	-8.88178	8.45817	-1.050	0.29372
## CityAugusta	-10.41782	8.78191	-1.186	0.23555
## CityAurora	0.96056	8.61513	0.111	0.91123
## CityAustin	-0.22341	4.39695	-0.051	0.95948
## CityBakersfield	-13.36382	7.11035	-1.879	0.06022 .
## CityBaltimore	6.38069	7.40243	0.862	0.38873
## CityBaton Rouge	-1.75663	7.94400	-0.221	0.82500
## CityBattle Creek	2.85435	11.21288	0.255	0.79907
## CityBeaufort	-5.07158	9.56763	-0.530	0.59608
## CityBeaumont	-7.91664	6.73741	-1.175	0.24002
## CityBellevue	5.87630	9.92784	0.592	0.55394
## CityBerkeley	0.85996	7.74522	0.111	0.91160
## CityBethesda	10.38943	8.21679	1.264	0.20612
## CityBethlehem	-21.54910	10.68868	-2.016	0.04383 *
## CityBillings	16.42390	8.33447	1.971	0.04881 *
## CityBiloxi	8.41036	10.27949	0.818	0.41329
## CityBirmingham	5.07944	7.36643	0.690	0.49051
## CityBismarck	-0.38600	9.92791	-0.039	0.96899
## CityBloomington	-11.65222	7.78496	-1.497	0.13450
## CityBoca Raton	-22.68943	11.32136	-2.004	0.04510 *
## CityBoise	9.53893	7.46861	1.277	0.20157
## CityBonita Springs	-23.26435	12.06871	-1.928	0.05394 .
## CityBoston	4.89698	7.50280	0.653	0.51398
## CityBoulder	-3.81980	9.88284	-0.387	0.69913
## CityBowie	0.58095	8.94039	0.065	0.94819
## CityBoynton Beach	-16.58756	12.54073	-1.323	0.18598
## CityBozeman	24.00557	8.67566	2.767	0.00567 **
## CityBradenton	-17.30112	10.92914	-1.583	0.11346
## CityBrea	-4.13508	8.02558	-0.515	0.60640
## CityBridgeport	10.64356	7.83014	1.359	0.17409
## CityBrockton	3.55125	8.38171	0.424	0.67180
## CityBronx	-11.63503	9.91779	-1.173	0.24078
## CityBrooklyn	-11.36234	9.66763	-1.175	0.23992
## CityBrooksville	-14.34874	12.06728	-1.189	0.23446
## CityBryan	13.51757	7.99842	1.690	0.09107 .

## CityBuffalo	-12.64500	9.91825	-1.275	0.20238	
## CityBurbank	-9.99960	7.64421	-1.308	0.19087	
## CityCambridge	-7.12491	11.07544	-0.643	0.52005	
## CityCamden	7.68011	12.36958	0.621	0.53469	
## CityCanton	-10.40735	8.67003	-1.200	0.23003	
## CityCape Coral	-29.83517	11.43210	-2.610	0.00908	**
## CityCarlsbad	-1.21840	9.53997	-0.128	0.89838	
## CityCarol Stream	1.14974	7.98126	0.144	0.88546	
## CityCarson City	6.86214	9.92944	0.691	0.48953	
## CityCedar Rapids	5.42761	8.33502	0.651	0.51495	
## CityChampaign	-0.77328	9.63209	-0.080	0.93602	
## CityChandler	-7.06249	8.82395	-0.800	0.42352	
## CityCharleston	-6.89600	8.86461	-0.778	0.43664	
## CityCharlotte	7.85036	7.37415	1.065	0.28710	
## CityCharlottesville	-13.00923	7.40675	-1.756	0.07906	.
## CityChattanooga	8.94184	12.10793	0.739	0.46023	
## CityChesapeake	-0.74833	6.84897	-0.109	0.91300	
## CityCheyenne	0.32327	11.03929	0.029	0.97664	
## CityChicago	-3.91092	6.92618	-0.565	0.57232	
## CityChico	1.04881	8.50836	0.123	0.90190	
## CityChula Vista	-16.88312	9.54165	-1.769	0.07687	.
## CityCincinnati	-6.58571	8.10363	-0.813	0.41643	
## CityClearwater	-16.04884	10.74944	-1.493	0.13548	
## CityCleveland	-2.41290	8.20929	-0.294	0.76883	
## CityCollege Station	5.12473	6.73468	0.761	0.44671	
## CityColorado Springs	-3.98250	9.36051	-0.425	0.67052	
## CityColumbia	0.04773	8.19333	0.006	0.99535	
## CityColumbus	-4.32576	8.10952	-0.533	0.59376	
## CityConcord	-22.96561	10.69204	-2.148	0.03175	*
## CityConroe	-2.66409	6.11530	-0.436	0.66311	
## CityCorona	-16.73963	8.23143	-2.034	0.04203	*
## CityCorpus Christi	-2.18337	5.02070	-0.435	0.66367	
## CityCrawfordsville	-1.69692	9.87141	-0.172	0.86352	
## CityCumming	-17.88596	10.80791	-1.655	0.09799	.
## CityDallas	-0.39338	4.33315	-0.091	0.92767	
## CityDanbury	18.23678	8.48229	2.150	0.03159	*
## CityDavenport	7.80644	8.33438	0.937	0.34897	
## CityDayton	-1.91192	8.24770	-0.232	0.81669	
## CityDaytona Beach	-17.66251	11.10880	-1.590	0.11189	
## CityDearborn	2.28331	10.12184	0.226	0.82153	
## CityDecatur	-8.68422	8.18787	-1.061	0.28890	
## CityDelray Beach	-12.60737	11.57676	-1.089	0.27618	
## CityDenton	2.87902	6.11380	0.471	0.63772	
## CityDenver	-3.17873	9.32595	-0.341	0.73323	
## CityDes Moines	6.25499	7.39260	0.846	0.39752	
## CityDetroit	1.13069	7.76362	0.146	0.88421	
## CityDulles	-3.23061	7.40667	-0.436	0.66272	
## CityDuluth	-9.79203	9.39231	-1.043	0.29719	
## CityDurham	10.42320	8.04379	1.296	0.19509	
## CityEast Saint Louis	-7.24780	7.98369	-0.908	0.36400	
## CityEdmond	20.79227	9.93211	2.093	0.03635	*
## CityEl Paso	-0.19958	4.31164	-0.046	0.96308	
## CityElizabeth	5.39741	13.27533	0.407	0.68433	
## CityElmira	-13.38168	10.64996	-1.257	0.20898	

## CityEnglewood	3.02400	12.44054	0.243	0.80795	
## CityErie	-26.62303	9.61338	-2.769	0.00563	**
## CityEscondido	0.92651	8.50946	0.109	0.91330	
## CityEugene	3.86726	13.84383	0.279	0.77999	
## CityEvanston	-4.90323	8.13670	-0.603	0.54679	
## CityEvansville	-8.15334	8.27050	-0.986	0.32425	
## CityEverett	0.45080	8.94012	0.050	0.95979	
## CityFairbanks	0.65008	8.48326	0.077	0.93892	
## CityFairfax	-3.85581	7.86384	-0.490	0.62392	
## CityFairfield	7.32925	9.32209	0.786	0.43176	
## CityFalls Church	3.66550	12.90747	0.284	0.77643	
## CityFargo	9.85763	8.67687	1.136	0.25596	
## CityFarmington	8.44480	9.15667	0.922	0.35643	
## CityFayetteville	2.81867	11.03691	0.255	0.79843	
## CityFlint	8.26146	8.56558	0.964	0.33483	
## CityFlorence	15.58090	14.54024	1.072	0.28395	
## CityFlushing	-11.19172	10.20365	-1.097	0.27275	
## CityFort Collins	-14.66461	14.98541	-0.979	0.32782	
## CityFort Lauderdale	-18.37442	10.70068	-1.717	0.08600	.
## CityFort Myers	-17.07429	11.16624	-1.529	0.12629	
## CityFort Pierce	-15.90453	11.10875	-1.432	0.15227	
## CityFort Smith	7.74712	9.32230	0.831	0.40598	
## CityFort Wayne	-6.85695	8.21949	-0.834	0.40418	
## CityFort Worth	-0.07179	4.61769	-0.016	0.98760	
## CityFrankfort	-0.60616	9.32417	-0.065	0.94817	
## CityFrederick	6.61742	8.94079	0.740	0.45924	
## CityFredericksburg	-12.11503	7.86488	-1.540	0.12351	
## CityFresno	-6.58178	6.89332	-0.955	0.33971	
## CityFullerton	-9.97380	8.50890	-1.172	0.24117	
## CityGadsden	5.66054	11.03694	0.513	0.60806	
## CityGainesville	-14.01559	9.90120	-1.416	0.15695	
## CityGaithersburg	-4.37899	13.84259	-0.316	0.75175	
## CityGalveston	-1.50064	6.38079	-0.235	0.81408	
## CityGarden Grove	0.25000	7.74590	0.032	0.97425	
## CityGarland	-4.25146	5.90824	-0.720	0.47181	
## CityGary	-0.81398	11.50421	-0.071	0.94359	
## CityGastonia	11.28520	11.03774	1.022	0.30662	
## CityGatesville	1.26724	7.99961	0.158	0.87414	
## CityGilbert	-4.78096	9.14764	-0.523	0.60124	
## CityGlendale	-8.51461	7.16880	-1.188	0.23498	
## CityGrand Forks	3.59227	8.67619	0.414	0.67886	
## CityGrand Junction	3.98228	10.94685	0.364	0.71603	
## CityGrand Rapids	0.16962	7.95365	0.021	0.98299	
## CityGreat Neck	2.62741	12.64474	0.208	0.83540	
## CityGreeley	-4.95098	10.94985	-0.452	0.65117	
## CityGreen Bay	5.55057	7.79415	0.712	0.47640	
## CityGreensboro	2.59740	7.54972	0.344	0.73083	
## CityGreenville	-1.41431	9.43491	-0.150	0.88085	
## CityGulfport	9.96450	11.49867	0.867	0.38620	
## CityHagerstown	8.26014	9.32212	0.886	0.37561	
## CityHamilton	-10.05776	9.56028	-1.052	0.29282	
## CityHampton	-7.61914	7.08514	-1.075	0.28225	
## CityHarrisburg	-22.64456	9.66052	-2.344	0.01910	*
## CityHartford	4.28995	7.53749	0.569	0.56927	

## CityHattiesburg	5.03284	10.66101	0.472	0.63689
## CityHayward	-12.01684	9.54144	-1.259	0.20792
## CityHelena	14.96458	9.32265	1.605	0.10850
## CityHenderson	8.91500	9.92917	0.898	0.36929
## CityHerndon	-12.65981	7.86426	-1.610	0.10749
## CityHialeah	-14.91552	12.06773	-1.236	0.21651
## CityHicksville	-9.97673	10.27908	-0.971	0.33179
## CityHigh Point	8.74680	9.92742	0.881	0.37831
## CityHollywood	-24.12746	12.54063	-1.924	0.05440 .
## CityHomestead	-26.23835	13.43657	-1.953	0.05089 .
## CityHonolulu	11.27347	7.49987	1.503	0.13284
## CityHot Springs National Park	13.81510	8.67943	1.592	0.11150
## CityHouston	1.96674	4.28879	0.459	0.64655
## CityHumble	-8.90792	7.99732	-1.114	0.26538
## CityHuntington	-5.82596	9.34968	-0.623	0.53323
## CityHuntington Beach	-16.25289	8.51010	-1.910	0.05620 .
## CityHuntsville	4.89734	6.73536	0.727	0.46718
## CityHyattsville	12.28067	9.92791	1.237	0.21613
## CityIdaho Falls	6.37282	9.92830	0.642	0.52097
## CityIndependence	1.49855	10.00408	0.150	0.88093
## CityIndianapolis	-4.01160	8.08510	-0.496	0.61979
## CityInglewood	-7.92916	7.37991	-1.074	0.28267
## CityIowa City	1.86179	9.32312	0.200	0.84172
## CityIrvine	-4.62901	7.37913	-0.627	0.53048
## CityIrving	-8.31227	5.48941	-1.514	0.13001
## CityJackson	6.44352	9.60993	0.671	0.50256
## CityJacksonville	-18.64837	10.67274	-1.747	0.08063 .
## CityJamaica	-11.07246	9.80868	-1.129	0.25900
## CityJefferson City	2.86320	8.43068	0.340	0.73416
## CityJeffersonville	-1.97194	9.87202	-0.200	0.84168
## CityJersey City	17.26750	11.89130	1.452	0.14652
## CityJohnson City	13.80593	13.18087	1.047	0.29494
## CityJohnstown	-14.08224	11.52664	-1.222	0.22186
## CityJoliet	-2.95909	8.61351	-0.344	0.73120
## CityJuneau	7.52093	11.03947	0.681	0.49572
## CityKalamazoo	5.99829	8.45159	0.710	0.47790
## CityKansas City	5.36826	7.45752	0.720	0.47164
## CityKaty	16.38785	9.33939	1.755	0.07935 .
## CityKent	0.57097	11.03656	0.052	0.95874
## CityKilleen	-1.47078	6.38024	-0.231	0.81769
## CityKissimmee	-34.07424	13.43516	-2.536	0.01123 *
## CityKnoxville	9.59017	11.96802	0.801	0.42298
## CityLafayette	-7.85394	8.09639	-0.970	0.33205
## CityLake Charles	3.64681	9.69254	0.376	0.70674
## CityLake Worth	-15.47834	10.98591	-1.409	0.15890
## CityLakeland	-16.17572	11.32078	-1.429	0.15309
## CityLakewood	4.73100	8.67803	0.545	0.58565
## CityLancaster	-18.45027	8.50891	-2.168	0.03017 *
## CityLansing	8.30941	8.28243	1.003	0.31577
## CityLaredo	8.50054	9.34202	0.910	0.36289
## CityLargo	-14.65488	11.16593	-1.312	0.18941
## CityLas Cruces	-5.66360	9.92601	-0.571	0.56830
## CityLas Vegas	6.76609	7.38257	0.916	0.35944
## CityLawrenceville	-8.24966	9.35879	-0.881	0.37808

## CityLees Summit	-1.68896	10.00763	-0.169	0.86598	
## CityLehigh Acres	-6.90104	12.06810	-0.572	0.56745	
## CityLevittown	-7.29791	15.03119	-0.486	0.62732	
## CityLexington	9.43215	7.49109	1.259	0.20803	
## CityLima	-4.59309	14.25345	-0.322	0.74728	
## CityLincoln	10.43206	7.79283	1.339	0.18072	
## CityLittle Rock	8.12010	7.57501	1.072	0.28378	
## CityLittleton	-1.53980	9.82707	-0.157	0.87549	
## CityLondon	12.98070	9.92670	1.308	0.19103	
## CityLong Beach	-6.07257	7.19963	-0.843	0.39900	
## CityLongview	-8.82492	12.53255	-0.704	0.48136	
## CityLoretto	-12.51322	11.87359	-1.054	0.29198	
## CityLos Angeles	-7.02190	6.83153	-1.028	0.30405	
## CityLouisville	5.42551	7.40675	0.733	0.46388	
## CityLubbock	1.25837	5.11646	0.246	0.80573	
## CityLynchburg	0.39762	6.66362	0.060	0.95242	
## CityLynn	4.93065	8.98406	0.549	0.58315	
## CityMacon	-11.84543	9.49080	-1.248	0.21204	
## CityMadison	6.87205	7.50823	0.915	0.36008	
## CityManassas	-11.20909	7.86450	-1.425	0.15412	
## CityManchester	30.93706	16.11199	1.920	0.05488	.
## CityMansfield	-0.49248	8.99928	-0.055	0.95636	
## CityMaple Plain	-16.59988	10.25558	-1.619	0.10557	
## CityMarietta	-9.47104	9.49250	-0.998	0.31844	
## CityMc Keesport	-30.67739	10.68833	-2.870	0.00411	**
## CityMelbourne	-14.25789	11.23539	-1.269	0.20448	
## CityMemphis	9.35362	11.89512	0.786	0.43169	
## CityMeridian	5.22992	10.06147	0.520	0.60322	
## CityMerrifield	-6.27463	7.08526	-0.886	0.37587	
## CityMesa	-9.73902	8.16908	-1.192	0.23323	
## CityMetairie	-9.89762	10.27193	-0.964	0.33530	
## CityMiami	-17.58605	10.59387	-1.660	0.09696	.
## CityMiami Beach	-9.02420	13.43459	-0.672	0.50179	
## CityMidland	3.35965	5.42982	0.619	0.53611	
## CityMigrate	-7.74836	11.03754	-0.702	0.48270	
## CityMilwaukee	5.01885	7.60418	0.660	0.50927	
## CityMinneapolis	-12.63126	9.85790	-1.281	0.20012	
## CityMissoula	-3.11747	9.32246	-0.334	0.73808	
## CityMobile	5.79238	7.58991	0.763	0.44539	
## CityModesto	0.28872	8.23097	0.035	0.97202	
## CityMonroe	-0.02151	8.63195	-0.002	0.99801	
## CityMontgomery	10.71123	7.44997	1.438	0.15055	
## CityMonticello	-13.98374	10.18574	-1.373	0.16984	
## CityMontpelier	10.08918	9.92826	1.016	0.30957	
## CityMoreno Valley	-16.17546	8.91416	-1.815	0.06963	.
## CityMorgantown	-4.69120	10.50371	-0.447	0.65516	
## CityMount Vernon	-18.66836	11.68983	-1.597	0.11032	
## CityMountain View	-9.87171	8.50908	-1.160	0.24603	
## CityMuncie	4.70033	10.44504	0.450	0.65272	
## CityMurfreesboro	6.90863	13.61628	0.507	0.61190	
## CityMuskegon	4.67831	10.12177	0.462	0.64395	
## CityMyrtle Beach	-14.85965	14.53068	-1.023	0.30651	
## CityNaperville	-4.90199	10.77370	-0.455	0.64913	
## CityNaples	-17.58578	10.82051	-1.625	0.10416	

## CityNashville	7.32175	11.94739	0.613	0.54001	
## CityNew Bedford	10.90383	9.36448	1.164	0.24431	
## CityNew Brunswick	4.38714	11.13291	0.394	0.69354	
## CityNew Castle	-14.75299	11.52659	-1.280	0.20062	
## CityNew Haven	5.89144	7.60424	0.775	0.43851	
## CityNew Hyde Park	-2.76040	10.86517	-0.254	0.79946	
## CityNew Orleans	-1.42418	7.82202	-0.182	0.85553	
## CityNew York City	-12.38470	9.55246	-1.296	0.19485	
## CityNewark	15.20095	9.95484	1.527	0.12681	
## CityNewport Beach	-7.98028	9.54106	-0.836	0.40295	
## CityNewport News	2.83063	6.51532	0.434	0.66397	
## CityNewton	3.32211	8.02709	0.414	0.67899	
## CityNorcross	-3.95481	10.80442	-0.366	0.71435	
## CityNorfolk	-2.13044	5.76950	-0.369	0.71195	
## CityNorman	10.44482	9.32296	1.120	0.26261	
## CityNorth Hollywood	-4.88045	8.23154	-0.593	0.55327	
## CityNorth Las Vegas	-0.40898	8.48384	-0.048	0.96155	
## CityNorth Little Rock	10.92759	8.67573	1.260	0.20787	
## CityNorth Port	-17.80963	11.77434	-1.513	0.13043	
## CityNorthridge	-1.82079	8.02677	-0.227	0.82056	
## CityNorwalk	8.46851	8.94156	0.947	0.34362	
## CityOakland	-5.90937	7.11001	-0.831	0.40593	
## CityOcala	-19.08421	11.32193	-1.686	0.09192	.
## CityOceanside	-5.57488	13.56698	-0.411	0.68115	
## CityOdessa	8.68879	5.23658	1.659	0.09711	.
## CityOgden	4.53934	8.12371	0.559	0.57633	
## CityOklahoma City	6.80845	7.37704	0.923	0.35608	
## CityOlympia	-0.11993	8.21830	-0.015	0.98836	
## CityOmaha	4.29599	7.47649	0.575	0.56558	
## CityOrange	-4.98250	7.33425	-0.679	0.49694	
## CityOrlando	-19.64242	10.67658	-1.840	0.06585	.
## CityOxnard	-9.03724	10.69478	-0.845	0.39813	
## CityPalatine	-7.00897	9.01029	-0.778	0.43666	
## CityPalm Bay	-16.78508	12.53964	-1.339	0.18076	
## CityPalmdale	-0.60644	9.54076	-0.064	0.94932	
## CityPalo Alto	-7.33989	8.23022	-0.892	0.37252	
## CityPanama City	-16.07424	13.43516	-1.196	0.23157	
## CityPasadena	-7.68249	6.63371	-1.158	0.24686	
## CityPaterson	12.01787	10.76019	1.117	0.26408	
## CityPensacola	-18.20205	10.83424	-1.680	0.09299	.
## CityPeoria	0.03684	6.96868	0.005	0.99578	
## CityPetaluma	-9.58815	9.53866	-1.005	0.31484	
## CityPhiladelphia	-25.33240	9.45045	-2.681	0.00737	**
## CityPhoenix	-6.12887	7.88652	-0.777	0.43711	
## CityPinellas Park	-24.60699	11.32140	-2.173	0.02978	*
## CityPittsburgh	-23.15413	9.39887	-2.464	0.01378	*
## CityPlano	5.67508	9.34333	0.607	0.54361	
## CityPocatello	10.36575	8.93955	1.160	0.24628	
## CityPomona	-3.33690	9.53996	-0.350	0.72651	
## CityPompano Beach	-13.16308	11.16711	-1.179	0.23854	
## CityPort Charlotte	-23.68073	11.77415	-2.011	0.04434	*
## CityPort Saint Lucie	-16.95729	11.43168	-1.483	0.13802	
## CityPort Washington	-15.49629	10.49392	-1.477	0.13980	
## CityPortland	6.94351	7.42369	0.935	0.34966	

## CityPortsmouth	11.99371	12.90626	0.929	0.35277
## CityPrescott	-1.55404	8.96319	-0.173	0.86236
## CityProvidence	10.58765	9.92738	1.067	0.28623
## CityProvo	10.18794	8.67680	1.174	0.24037
## CityPueblo	1.35844	9.78265	0.139	0.88956
## CityPunta Gorda	-16.10485	11.23559	-1.433	0.15179
## CityRacine	11.94384	9.32286	1.281	0.20019
## CityRaleigh	8.19695	7.52713	1.089	0.27620
## CityReading	-23.02981	10.18727	-2.261	0.02381 *
## CityRedwood City	-3.29757	8.90943	-0.370	0.71130
## CityReno	8.96960	7.62068	1.177	0.23923
## CityReston	-0.64554	6.21095	-0.104	0.91722
## CityRichmond	-0.58678	5.38022	-0.109	0.91316
## CityRidgely	17.76863	11.03672	1.610	0.10745
## CityRiverside	-7.58301	7.56111	-1.003	0.31595
## CityRoanoke	-5.80499	5.58266	-1.040	0.29846
## CityRochester	-11.22535	9.56421	-1.174	0.24056
## CityRockford	-3.49835	7.45640	-0.469	0.63896
## CityRockville	3.12561	13.84447	0.226	0.82139
## CityRound Rock	6.83225	6.73508	1.014	0.31041
## CitySacramento	-8.80198	6.80684	-1.293	0.19602
## CitySaginaw	-1.40665	8.35994	-0.168	0.86638
## CitySaint Augustine	-19.49757	12.06835	-1.616	0.10623
## CitySaint Cloud	-6.96980	10.57690	-0.659	0.50994
## CitySaint Joseph	8.77812	11.11411	0.790	0.42966
## CitySaint Louis	3.74190	7.51234	0.498	0.61843
## CitySaint Paul	-9.81854	9.90476	-0.991	0.32158
## CitySaint Petersburg	-14.17658	10.76634	-1.317	0.18797
## CitySalem	2.18556	8.48218	0.258	0.79667
## CitySalinas	-1.73118	8.50844	-0.203	0.83878
## CitySalt Lake City	5.94622	7.41029	0.802	0.42233
## CitySan Angelo	10.70210	8.00040	1.338	0.18104
## CitySan Antonio	-2.30844	4.46529	-0.517	0.60519
## CitySan Bernardino	-11.70354	7.22801	-1.619	0.10545
## CitySan Diego	-10.34878	6.82609	-1.516	0.12955
## CitySan Francisco	-6.10473	6.84800	-0.891	0.37271
## CitySan Jose	-8.94967	6.99920	-1.279	0.20106
## CitySan Luis Obispo	-17.12213	9.54354	-1.794	0.07284 .
## CitySan Mateo	-9.86188	8.51154	-1.159	0.24664
## CitySan Rafael	-2.42371	8.91097	-0.272	0.78564
## CitySandy	4.05067	8.67924	0.467	0.64072
## CitySanta Ana	-6.60391	8.23494	-0.802	0.42262
## CitySanta Barbara	-2.91031	7.43155	-0.392	0.69535
## CitySanta Clara	-19.97021	13.56817	-1.472	0.14111
## CitySanta Cruz	11.60425	13.57137	0.855	0.39255
## CitySanta Fe	14.50793	8.94089	1.623	0.10471
## CitySanta Monica	-3.10952	8.23233	-0.378	0.70565
## CitySanta Rosa	9.38948	9.54077	0.984	0.32508
## CitySarasota	-14.76746	11.11022	-1.329	0.18383
## CitySavannah	-5.78459	8.85119	-0.654	0.51343
## CitySchaumburg	-5.58179	9.63383	-0.579	0.56234
## CitySchenectady	-13.66627	10.00530	-1.366	0.17201
## CityScottsdale	-7.70512	8.34969	-0.923	0.35614
## CityScranton	-19.25545	10.09326	-1.908	0.05646 .

## CitySeattle	4.75576	7.38549	0.644	0.51964
## CitySeminole	-15.80222	11.77489	-1.342	0.17963
## CityShawnee Mission	0.57355	9.08028	0.063	0.94964
## CityShreveport	-3.41697	7.99860	-0.427	0.66925
## CitySilver Spring	5.73823	8.04357	0.713	0.47563
## CitySimi Valley	-14.24610	8.50844	-1.674	0.09411 .
## CitySioux City	7.80151	8.94128	0.873	0.38295
## CitySioux Falls	13.90827	7.73171	1.799	0.07208 .
## CitySouth Bend	-1.28801	8.36178	-0.154	0.87759
## CitySouth Lake Tahoe	-0.88808	10.69738	-0.083	0.93384
## CitySouthfield	3.48850	9.15613	0.381	0.70321
## CitySparks	16.71535	9.32250	1.793	0.07301 .
## CitySpartanburg	7.00724	9.97789	0.702	0.48253
## CitySpokane	8.01869	7.50847	1.068	0.28558
## CitySpring	-1.28135	5.49013	-0.233	0.81546
## CitySpring Hill	-10.60519	11.57646	-0.916	0.35965
## CitySpringfield	-0.98908	6.71322	-0.147	0.88287
## CityStamford	7.06729	8.04432	0.879	0.37968
## CityStaten Island	-10.80067	10.37539	-1.041	0.29792
## CitySterling	-1.35170	7.08504	-0.191	0.84870
## CityStockton	-6.07049	7.29485	-0.832	0.40535
## CitySuffolk	-6.86536	8.57040	-0.801	0.42313
## CitySunnyvale	-9.94880	7.86999	-1.264	0.20622
## CitySyracuse	-8.93310	10.00596	-0.893	0.37201
## CityTacoma	10.96399	7.63866	1.435	0.15124
## CityTallahassee	-14.14091	10.98599	-1.287	0.19808
## CityTampa	-18.78769	10.64707	-1.765	0.07768 .
## CityTempe	-12.52398	9.39688	-1.333	0.18265
## CityTemple	0.69273	8.00160	0.087	0.93101
## CityTerre Haute	-10.08424	9.08296	-1.110	0.26694
## CityTexarkana	-1.57435	6.73576	-0.234	0.81520
## CityToledo	-6.83300	8.29955	-0.823	0.41037
## CityTopeka	-5.82939	9.11039	-0.640	0.52228
## CityTorrance	-11.35709	7.64430	-1.486	0.13741
## CityTrenton	14.86536	10.60644	1.402	0.16110
## CityTroy	-9.39795	11.21210	-0.838	0.40195
## CityTucson	-5.27886	7.97818	-0.662	0.50821
## CityTulsa	4.93250	7.40685	0.666	0.50547
## CityTuscaloosa	4.50175	8.33337	0.540	0.58907
## CityTyler	-2.25430	5.02046	-0.449	0.65343
## CityUtica	-21.72501	11.69338	-1.858	0.06323 .
## CityValdosta	-15.35390	10.80178	-1.421	0.15524
## CityValley Forge	-17.00643	15.03581	-1.131	0.25807
## CityVan Nuys	-7.86325	7.56302	-1.040	0.29852
## CityVancouver	4.77739	8.94166	0.534	0.59316
## CityVentura	-15.30752	8.90848	-1.718	0.08578 .
## CityVero Beach	-19.09309	11.02157	-1.732	0.08326 .
## CityVienna	-8.31066	7.08453	-1.173	0.24081
## CityVirginia Beach	0.74862	6.02040	0.124	0.90104
## CityVisalia	-2.27530	8.50815	-0.267	0.78915
## CityWaco	-2.15734	5.11597	-0.422	0.67327
## CityWaltham	9.18558	9.96576	0.922	0.35671
## CityWarren	-6.00947	8.90586	-0.675	0.49984
## CityWashington	5.76003	7.25081	0.794	0.42699

## CityWaterbury	9.22186	7.97684	1.156	0.24769
## CityWaterloo	27.19547	13.84255	1.965	0.04950 *
## CityWatertown	9.74217	8.98608	1.084	0.27834
## CityWest Hartford	4.40755	9.32185	0.473	0.63636
## CityWest Palm Beach	-16.30226	10.77542	-1.513	0.13035
## CityWhite Plains	-6.66072	10.20239	-0.653	0.51387
## CityWhittier	-4.73797	8.50928	-0.557	0.57768
## CityWichita	1.25222	9.11664	0.137	0.89075
## CityWichita Falls	-8.01180	6.38402	-1.255	0.20953
## CityWilkes Barre	-20.64228	9.89934	-2.085	0.03709 *
## CityWilmington	17.21297	8.33420	2.065	0.03893 *
## CityWinston Salem	6.07392	7.65902	0.793	0.42778
## CityWinter Haven	-13.33819	11.57484	-1.152	0.24922
## CityWoburn	-2.02236	9.36561	-0.216	0.82905
## CityWorcester	10.95146	8.72185	1.256	0.20929
## CityYakima	9.81658	9.92765	0.989	0.32279
## CityYork	-22.57472	11.52662	-1.958	0.05021 .
## CityYoung America	-16.81475	10.18552	-1.651	0.09881 .
## CityYoungstown	-8.53087	8.61772	-0.990	0.32225
## CityZephyrhills	-15.96803	13.43944	-1.188	0.23482
## SentimentNeutral	-0.49541	0.36902	-1.343	0.17948
## SentimentPositive	-0.34633	0.48155	-0.719	0.47204
## SentimentVery Negative	-0.67454	0.40634	-1.660	0.09695 .
## SentimentVery Positive	-1.18221	0.51323	-2.303	0.02128 *
## StateAlaska	NA	NA	NA	NA
## StateArizona	11.51342	8.80373	1.308	0.19099
## StateArkansas	NA	NA	NA	NA
## StateCalifornia	14.59122	7.84923	1.859	0.06308 .
## StateColorado	7.13654	10.10391	0.706	0.48002
## StateConnecticut	NA	NA	NA	NA
## StateDelaware	-8.96178	4.87830	-1.837	0.06624 .
## StateDistrict of Columbia	NA	NA	NA	NA
## StateFlorida	24.43244	11.30622	2.161	0.03073 *
## StateGeorgia	13.93148	9.34094	1.491	0.13589
## StateHawaii	NA	NA	NA	NA
## StateIdaho	NA	NA	NA	NA
## StateIllinois	11.02760	7.96306	1.385	0.16614
## StateIndiana	13.18729	8.92724	1.477	0.13967
## StateIowa	NA	NA	NA	NA
## StateKansas	8.42411	9.79760	0.860	0.38992
## StateKentucky	NA	NA	NA	NA
## StateLouisiana	9.54498	8.72476	1.094	0.27399
## StateMaine	-12.84703	5.56963	-2.307	0.02111 *
## StateMaryland	NA	NA	NA	NA
## StateMassachusetts	4.23694	8.36289	0.507	0.61243
## StateMichigan	4.16658	8.54598	0.488	0.62588
## StateMinnesota	20.46055	10.56187	1.937	0.05276 .
## StateMississippi	2.79134	10.13957	0.275	0.78310
## StateMissouri	3.17119	8.40881	0.377	0.70609
## StateMontana	NA	NA	NA	NA
## StateNebraska	NA	NA	NA	NA
## StateNevada	NA	NA	NA	NA
## StateNew Hampshire	-19.32306	15.17023	-1.274	0.20280
## StateNew Jersey	-7.90097	7.37779	-1.071	0.28425

```
## StateNew Mexico          NA          NA          NA          NA
## StateNew York            18.78083    10.35675    1.813    0.06981 .
## StateNorth Carolina      NA          NA          NA          NA
## StateNorth Dakota        NA          NA          NA          NA
## StateOhio                13.11401    8.97975    1.460    0.14423
## StateOklahoma            NA          NA          NA          NA
## StateOregon              NA          NA          NA          NA
## StatePennsylvania        30.31424    10.17142    2.980    0.00289 **
## StateRhode Island        NA          NA          NA          NA
## StateSouth Carolina      7.72691    9.41622    0.821    0.41190
## StateSouth Dakota        NA          NA          NA          NA
## StateTennessee          -2.16285    12.48955   -0.173    0.86252
## StateTexas               7.02039    5.87904    1.194    0.23246
## StateUtah                NA          NA          NA          NA
## StateVermont             NA          NA          NA          NA
## StateVirginia            9.20176    6.63673    1.386    0.16564
## StateWashington          NA          NA          NA          NA
## StateWest Virginia       13.32143    9.97752    1.335    0.18187
## StateWisconsin           NA          NA          NA          NA
## StateWyoming             NA          NA          NA          NA
## ReasonPayments           0.39532    0.28436    1.390    0.16451
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 11.81 on 6960 degrees of freedom
## Multiple R-squared:  0.074, Adjusted R-squared:  0.009339
## F-statistic: 1.144 on 486 and 6960 DF, p-value: 0.0182
```

```
# lets try step selection model
step_lm <- step(full_lm,train_data,direction = "both")
```

```
## Start: AIC=37245.92
## Call:Duration.In.Minutes ~ City + Sentiment + State + Reason
##
##           Df Sum of Sq    RSS   AIC
## - City      431      66391 1037547 36876
## - State      26       6466  977621 37243
## - Sentiment   4        912  972067 37245
## <none>                        971156 37246
## - Reason      1        270  971425 37246
##
## Step: AIC=36876.37
## Call:Duration.In.Minutes ~ Sentiment + State + Reason
##
##           Df Sum of Sq    RSS   AIC
## - State     50     9979.8 1047527 36848
## - Sentiment  4       866.4 1038413 36875
## - Reason     1       248.4 1037795 36876
## <none>                1037547 36876
##
## Step: AIC=36847.66
## Call:Duration.In.Minutes ~ Sentiment + Reason
##
##           Df Sum of Sq    RSS   AIC
```

```
## - Sentiment 4 982.55 1048509 36847
## - Reason 1 248.99 1047776 36847
## <none> 1047527 36848
##
## Step: AIC=36846.64
## Call.Duration.In.Minutes ~ Reason
##
## Df Sum of Sq RSS AIC
## - Reason 1 254.53 1048764 36846
## <none> 1048509 36847
##
## Step: AIC=36846.45
## Call.Duration.In.Minutes ~ 1
```

```
summary(step_lm)
```

```
##
## Call:
## lm(formula = Call.Duration.In.Minutes ~ 1, data = train_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.1873 -10.1873  -0.1873  10.8127  19.8127
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  25.1873      0.1375   183.1  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 11.87 on 7446 degrees of freedom
```

```
### step regression chose to eliminate all variables
```

```
### though we could simply take average of call duration of each reason and use this in predicting tota
```

```
# Calculate average call duration by reason
```

```
library(dplyr)
```

```
avg_call_duration <- data %>%
```

```
  group_by(Reason) %>%
```

```
  summarize(Average_Call_Duration = mean(Call.Duration.In.Minutes, na.rm = TRUE))
```

```
# Display the result
```

```
avg_call_duration
```

```
## # A tibble: 3 x 2
##   Reason      Average_Call_Duration
##   <fct>          <dbl>
## 1 Billing Question      25.0
## 2 Payments             25.2
## 3 Service Outage       25.1
```

```

### this gives a rounded 25 min duration for each reason, which basically says there is no difference in
### therefor answering our first question: using the data we have to predict call duration will not help
### (i did not bother to use the testing data because it was obvious it would not show us any good results)

### second question: "is there any correlation between channel (email,web,chatbot,call_center) and Csat
### is there a way of service that is more liked than others? which way of service will you recommend to
### looking at the score column, there are a lot of non rated experiences
table(is.na(data$Csat.Score))

```

```

##
## FALSE TRUE
## 12271 20670

```

```

# picking out only experiences with score rating
rated_data = data[!is.na(data$Csat.Score), ]

#checking if it worked
table(is.na(rated_data$Csat.Score))

```

```

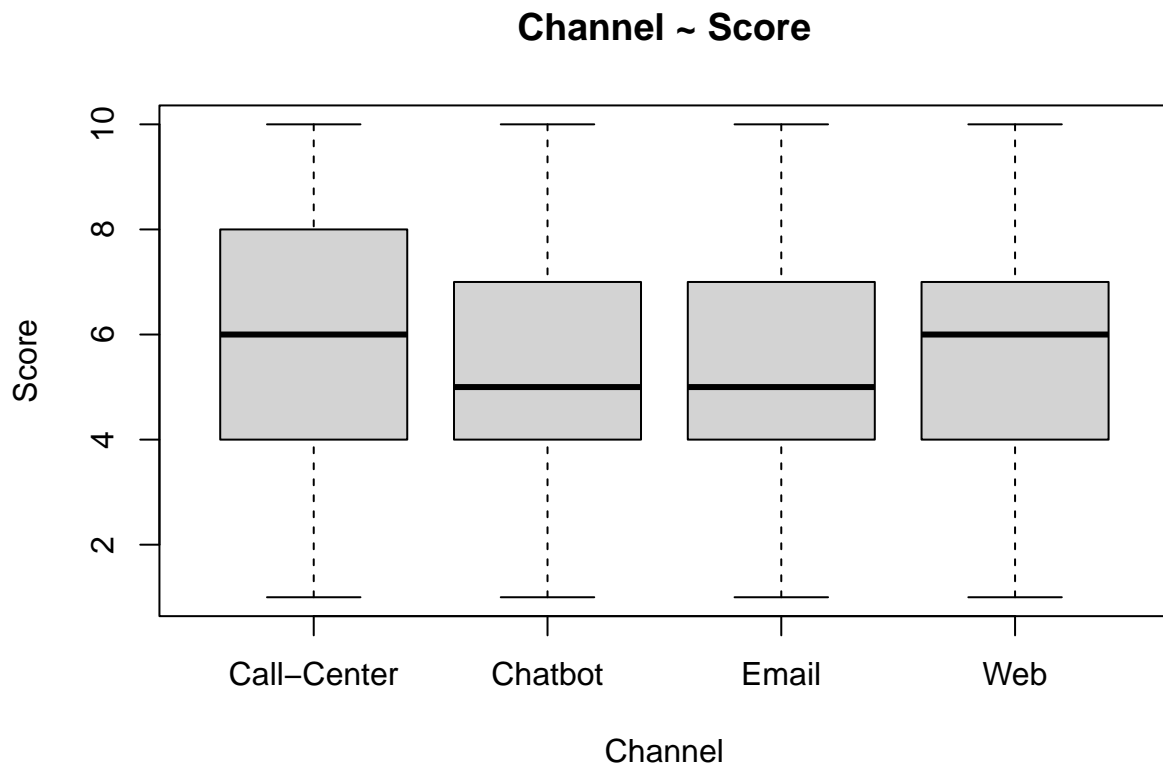
##
## FALSE
## 12271

```

```

#visualize graph between score and channel
plot(rated_data$Channel, rated_data$Csat.Score,
     main = "Channel ~ Score",
     xlab = "Channel",
     ylab = "Score")

```



looking at the graph generated, we see how call-center and web have a higher mean score than chatbot
 ### lets further analyze if its significant

```
# conducting a anova test
anova_result <- aov(Csat.Score ~ Channel, data = rated_data)
summary(anova_result)
```

```
##              Df Sum Sq Mean Sq F value Pr(>F)
## Channel      3      43    14.46   2.573 0.0523 .
## Residuals 12267   68938     5.62
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

p-value is just over the significance level of 5%

###lets conduct a tukey test to see which category is the reason for the significant mean difference

```
#tukey test
TukeyHSD(anova_result)
```

```
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = Csat.Score ~ Channel, data = rated_data)
##
```

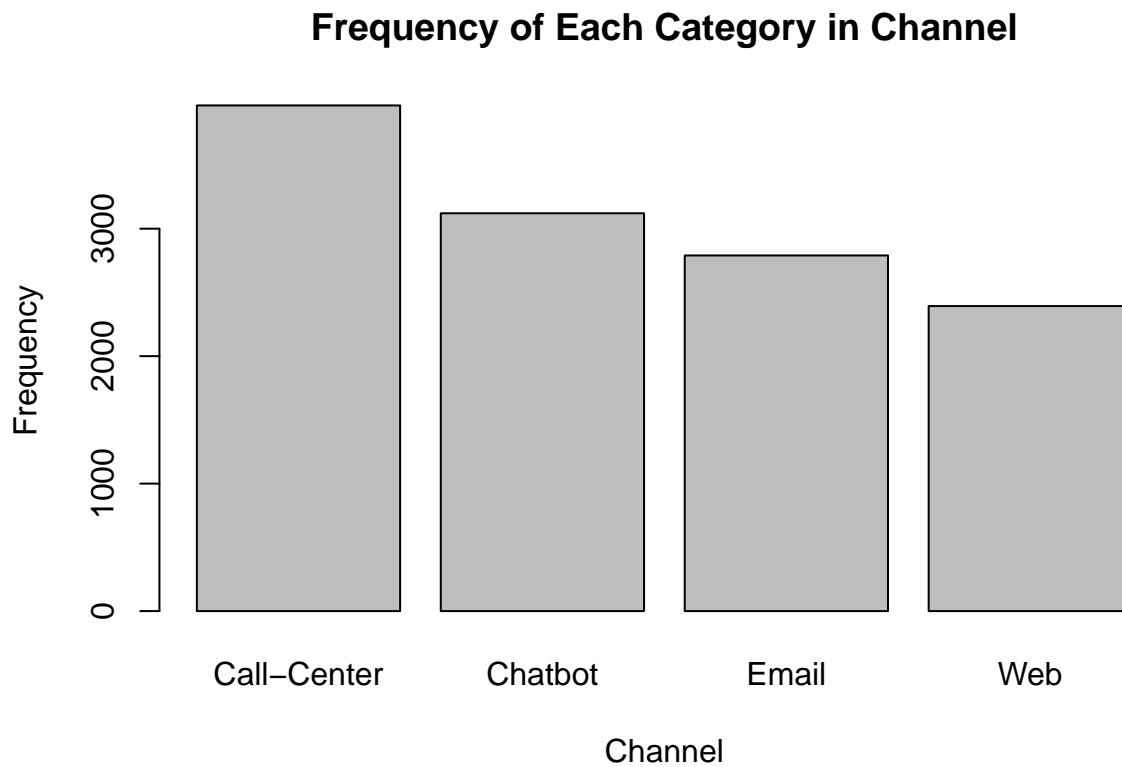
```
## $Channel
##               diff          lwr          upr          p adj
## Chatbot-Call-Center -0.12083944 -0.26657707 0.02489818 0.1435055
## Email-Call-Center   -0.13158938 -0.28208767 0.01890892 0.1109563
## Web-Call-Center     -0.02158394 -0.17924118 0.13607330 0.9850716
## Email-Chatbot       -0.01074993 -0.16944715 0.14794728 0.9981276
## Web-Chatbot         0.09925551 -0.06624639 0.26475740 0.4129726
## Web-Email           0.11000544 -0.05970360 0.27971447 0.3421377
```

```
### the biggest difference is between email and call-center services which puts call-services most sati
### maybe this can indicate the need to focus in improving email services...
```

```
### we do need to consider the amount of entries per channel category to make sure we have a balanced d
### looking at ALL frequencies of channel and ONLY rated frequencies of channel, it looks like the samp
### almost the same RELETIVE frequency of channel categories. this may further support the significance
### seeing the frequency for the full data, this can also mean that people automatically turn to the ca
channel_freq <- table(rated_data$Channel)
channel_freq
```

```
##
## Call-Center      Chatbot      Email      Web
##          3967          3121          2790          2393
```

```
barplot(channel_freq,
        main = "Frequency of Each Category in Channel",
        xlab = "Channel",
        ylab = "Frequency")
```

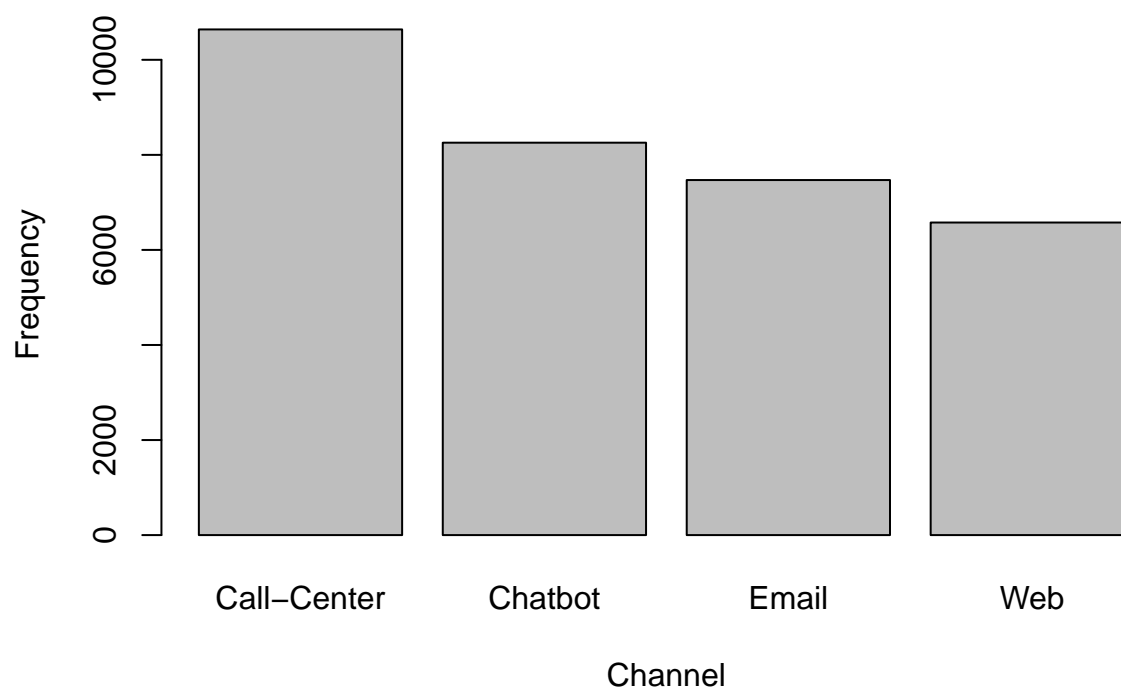


```
full_channel_freq <- table(data$Channel)
full_channel_freq
```

```
##
## Call-Center    Chatbot    Email    Web
##      10639         8256       7470    6576
```

```
barplot(full_channel_freq,
  main = "Full Frequency of Each Category in Channel",
  xlab = "Channel",
  ylab = "Frequency")
```

Full Frequency of Each Category in Channel



third question: "what are the most common reasons people call for and can we improve costumer satis
we will analyze the reasons that are most frequent, and then see if the reasons have any correlation

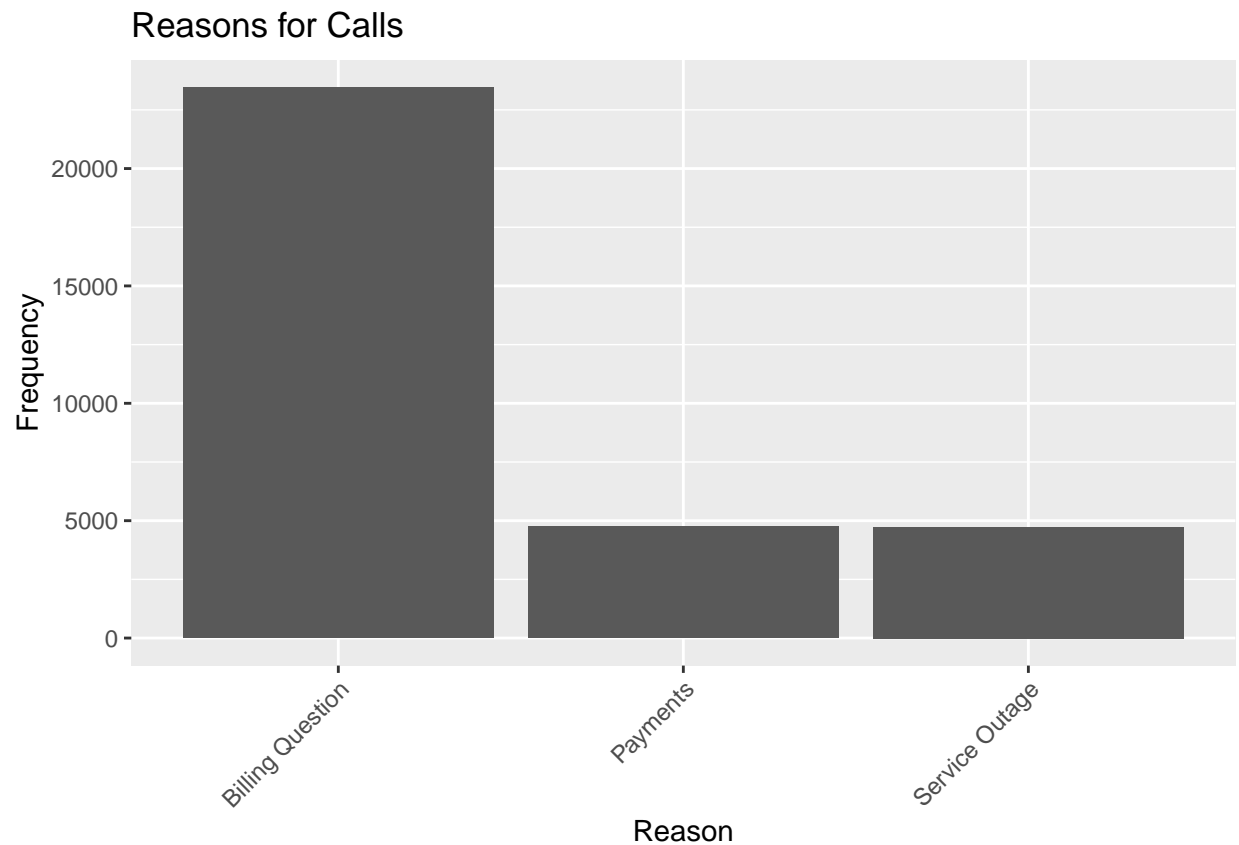
```
# calculate frequency of each reason level
table(data$Reason)
```

```
##
## Billing Question      Payments    Service Outage
##           23462             4749             4730
```

```
# bar plot of the most common reasons for calls
library(ggplot2)
```

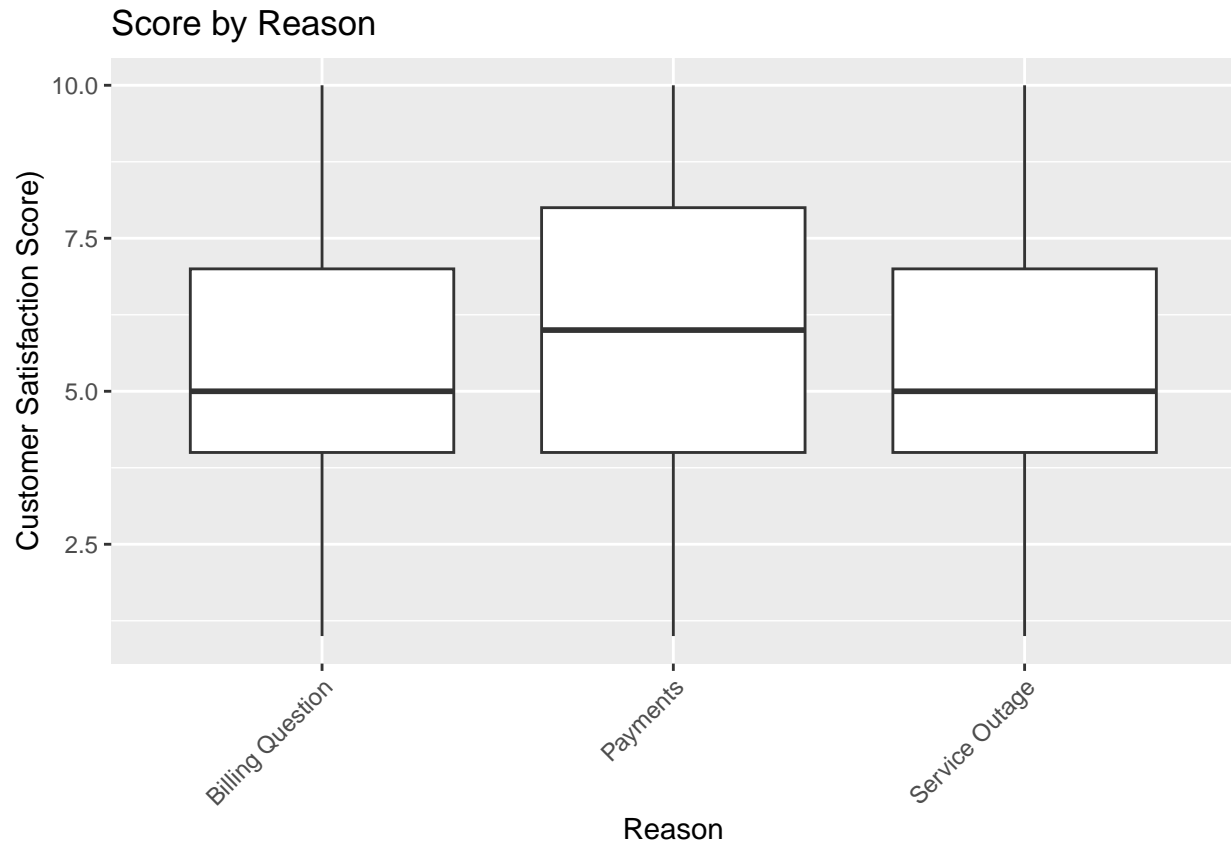
```
## Warning: package 'ggplot2' was built under R version 4.4.2
```

```
ggplot(data, aes(x = Reason)) +
  geom_bar() +
  labs(title = "Reasons for Calls", x = "Reason", y = "Frequency") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```

```
# boxplot to compare Csat.Score across different reasons
ggplot(data, aes(x = Reason, y = Csat.Score)) +
  geom_boxplot() +
  labs(title = "Score by Reason", x = "Reason", y = "Customer Satisfaction Score") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```

```
## Warning: Removed 20670 rows containing non-finite outside the scale range
## ('stat_boxplot()').
```



looking at the box plot display we can see how payments reason services have better satisfaction scores

```
library(dplyr)
avg_score <- data %>%
  group_by(Reason) %>%
  summarize(Average_score = mean(Csate.Score, na.rm = TRUE))

# Display the result
avg_score
```

```
## # A tibble: 3 x 2
##   Reason      Average_score
##   <fct>         <dbl>
## 1 Billing Question      5.54
## 2 Payments             5.63
## 3 Service Outage      5.52
```

looking at the average score per reason, the differences in average score doesn't look that significant

let's perform an ANOVA test just to make sure

```
anova_result <- aov(Csate.Score ~ Reason, data = data)
```

Display the summary of the ANOVA result

```
summary(anova_result)
```

```
##              Df Sum Sq Mean Sq F value Pr(>F)
```

```
## Reason          2      16   7.823   1.392  0.249
## Residuals    12268  68965   5.622
## 20670 observations deleted due to missingness
```

```
### according to the anova results, the difference between average score of the three types of reasons
```