

# Incident Regression

Math 564 Final Project

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## Data Preparation and Cleaning

```
incident_log<-read.table("incident_event_log.csv", sep=",", header=T, na=c("?", "NA"))

incident_log$sys_created_at <- as.POSIXct(strptime(incident_log$sys_created_at, "%d/%m/%Y %H:%M"))

incident_log$resolved_at <- as.POSIXct(strptime(incident_log$resolved_at, "%d/%m/%Y %H:%M"))

incident_log$sys_updated_at <- as.POSIXct(strptime(incident_log$sys_updated_at, "%d/%m/%Y %H:%M"))

incident_log$time_diff_res_create<-as.numeric(difftime(incident_log$resolved_at, incident_log$sys_created_at))

incident_log$time_diff_res_update<-as.numeric(difftime(incident_log$resolved_at, incident_log$sys_updated_at))

incident_log<-within(incident_log,{interval<-NA
interval[time_diff_res_update<1]<- "Within a Day"
interval[time_diff_res_update>=1 & time_diff_res_update<7]<- "Within a Week"
interval[time_diff_res_update>=7 & time_diff_res_update<14]<- "Within 2 Weeks"
interval[time_diff_res_update>=14 & time_diff_res_update<30]<- "Within a Month"
interval[time_diff_res_update>=30 & time_diff_res_update<183]<- "Within 6 Months"
interval[time_diff_res_update>=183]<- "More than 6 Months"})

incident_log<-subset(incident_log,incident_state!="Closed")

incident_log<-subset(incident_log,select= c(number, incident_state, reassignment_count,reopen_count,sys)

incident_log<-subset(incident_log,time_diff_res_update!=0 & time_diff_res_update>0)

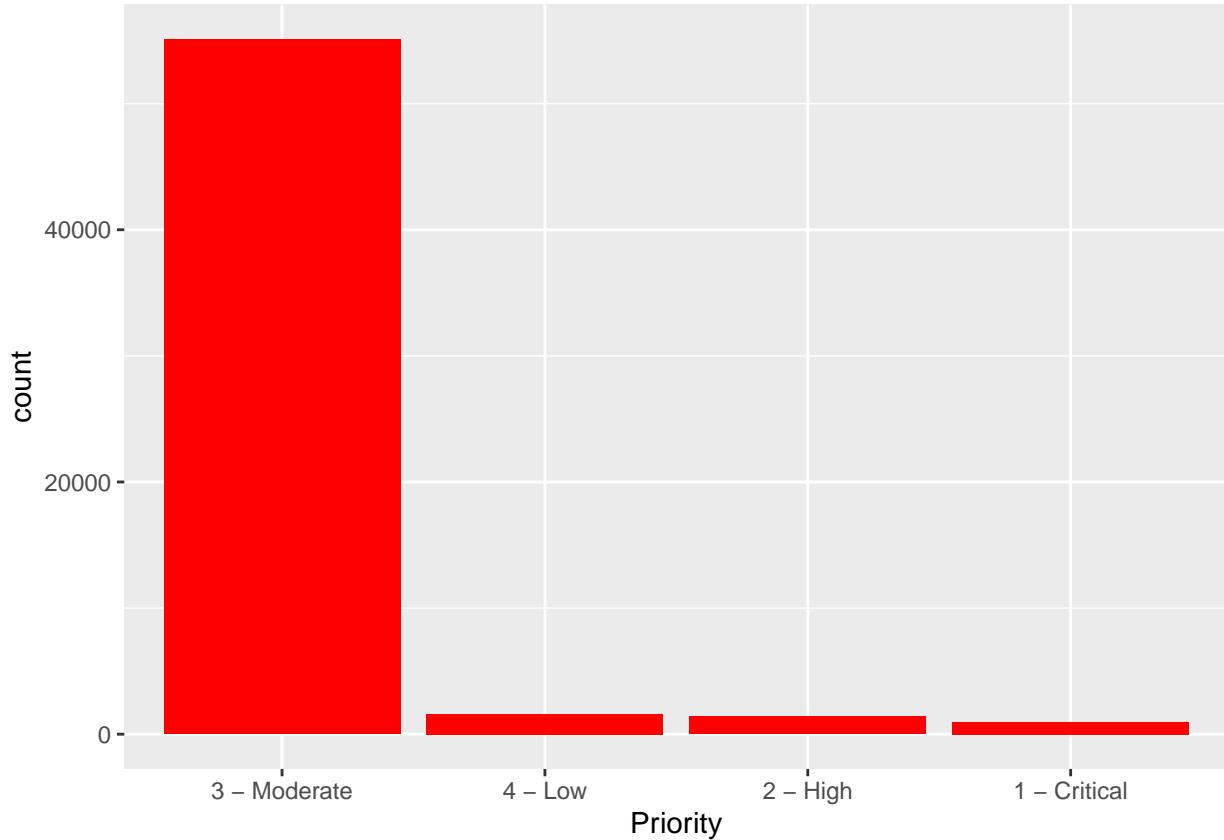
incident_log<-subset(incident_log,time_diff_res_create!="NA")

incident_log <- incident_log %>%
  mutate(category = replace(category, is.na(category), "None"), subcategory = replace(subcategory, is.na(subcategory), "None"))

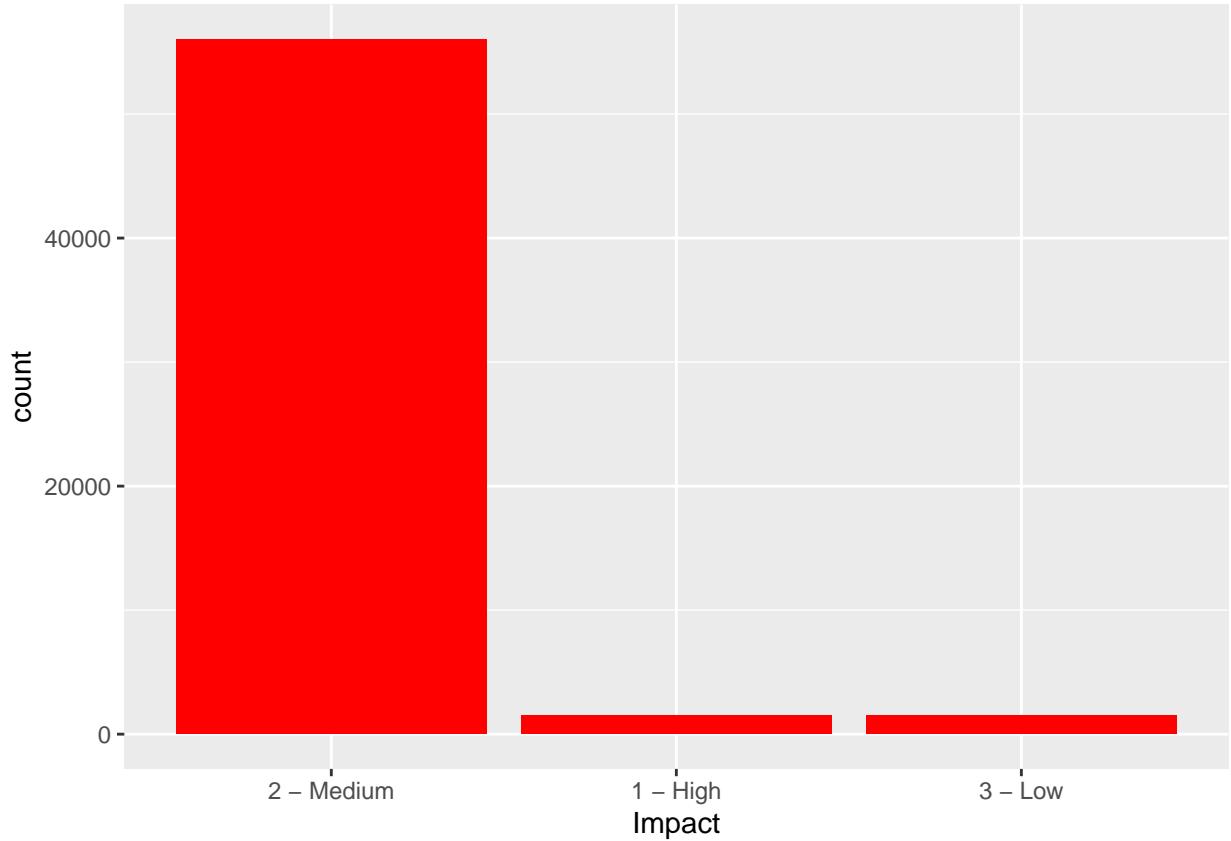
incident_log<-subset(incident_log,select=-c(sys_updated_at,sys_created_at,resolved_at))
```

## Data Visualization

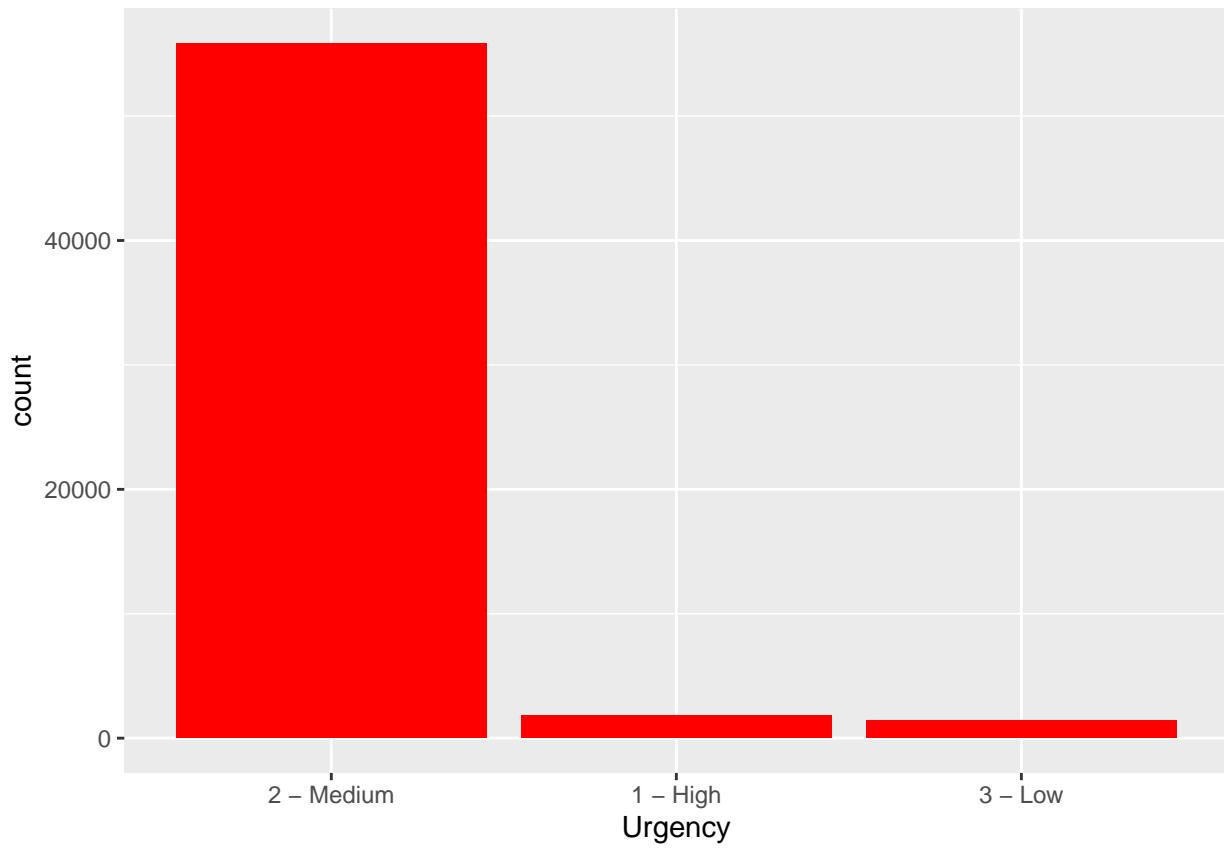
```
ggplot(incident_log, aes(x=reorder(priority, priority, function(x)-length(x)))) +  
  geom_bar(fill='red') +  labs(x='Priority')
```



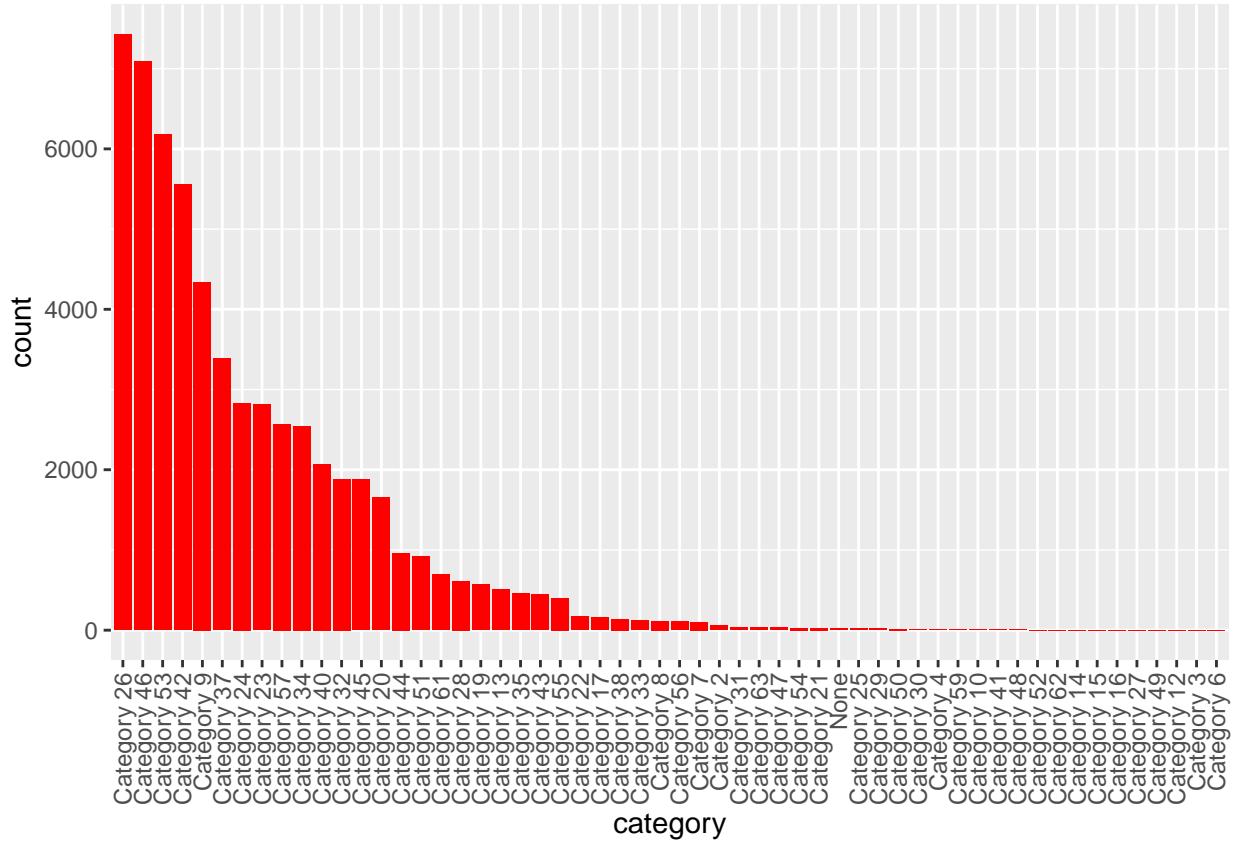
```
ggplot(incident_log, aes(x=reorder(impact, impact, function(x)-length(x)))) +  
  geom_bar(fill='red') +  labs(x='Impact')
```



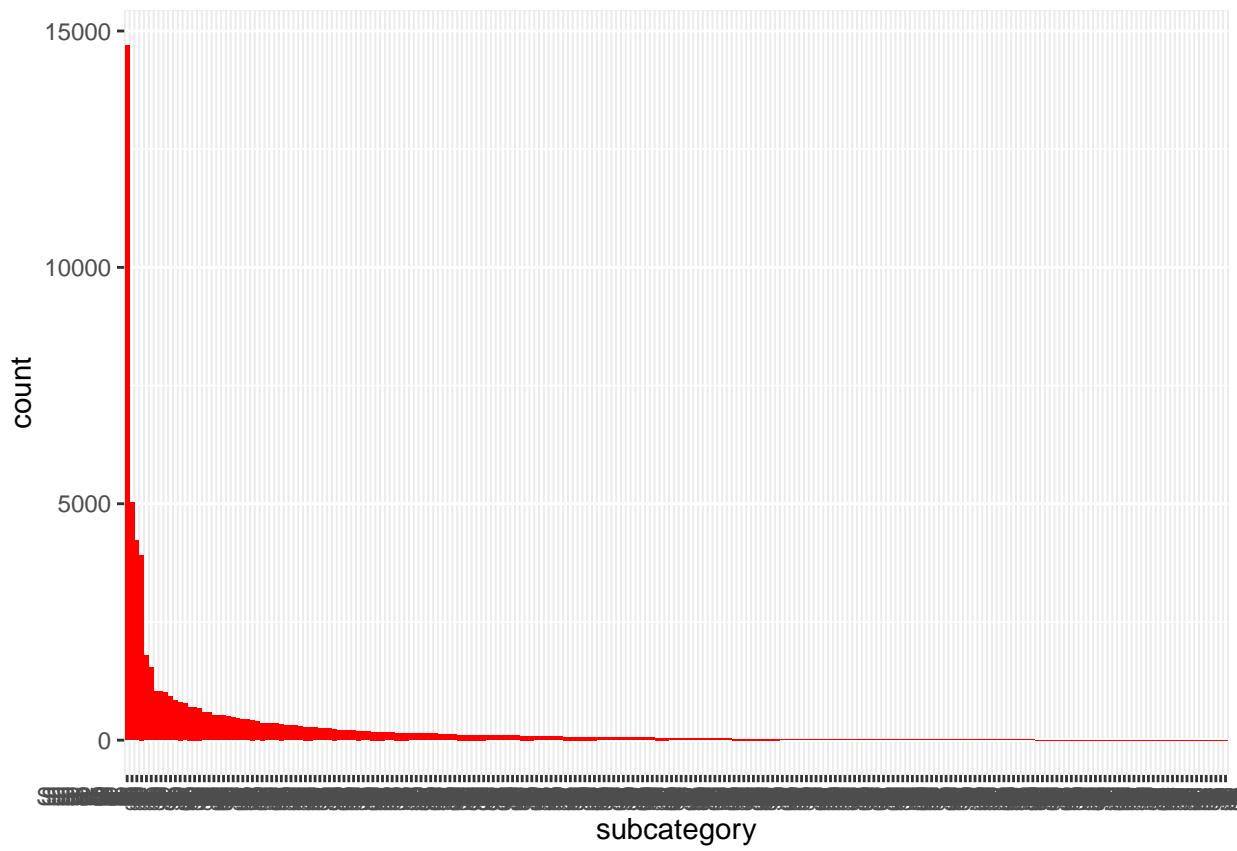
```
ggplot(incident_log, aes(x=reorder(urgency, urgency, function(x)-length(x)))) +  
  geom_bar(fill='red') +  labs(x='Urgency')
```



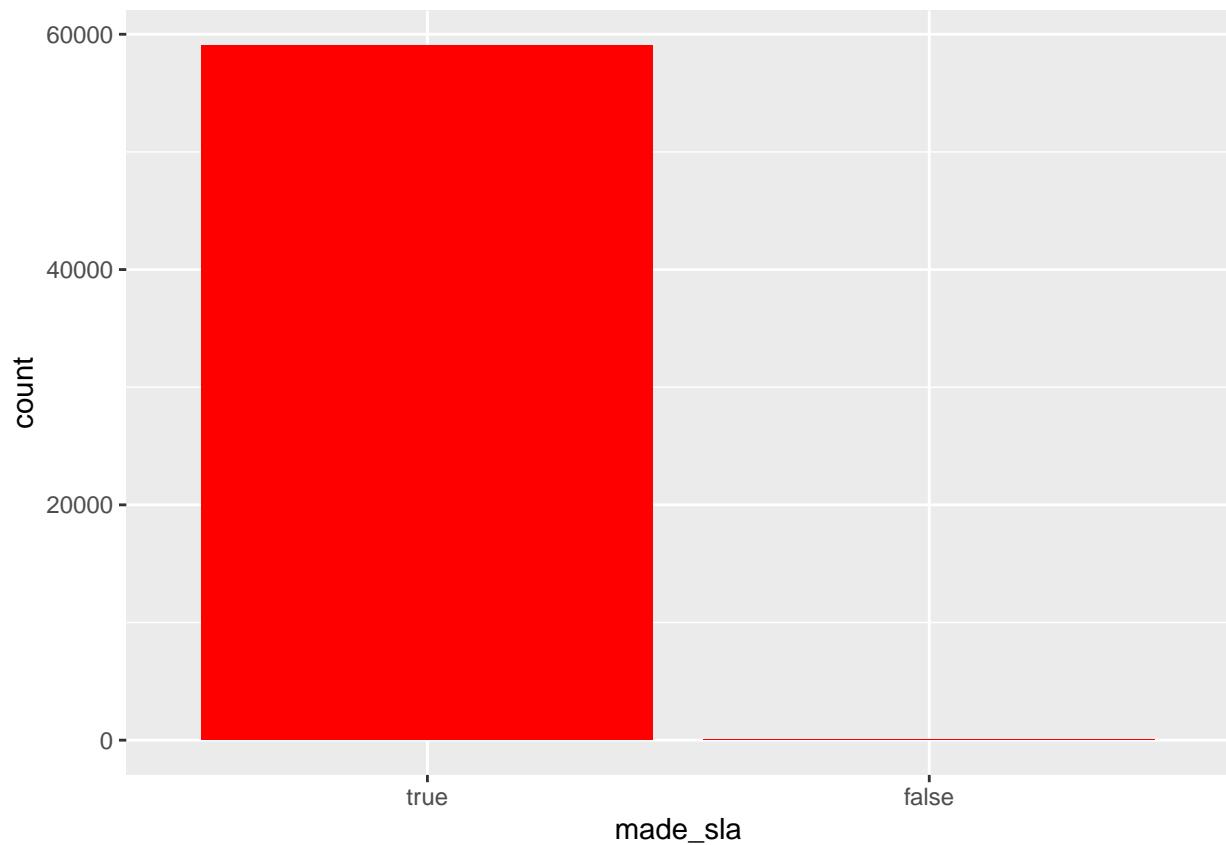
```
ggplot(incident_log, aes(x=reorder(category, category, function(x)-length(x)))) +  
  geom_bar(fill='red') +  labs(x='category')+theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hj
```



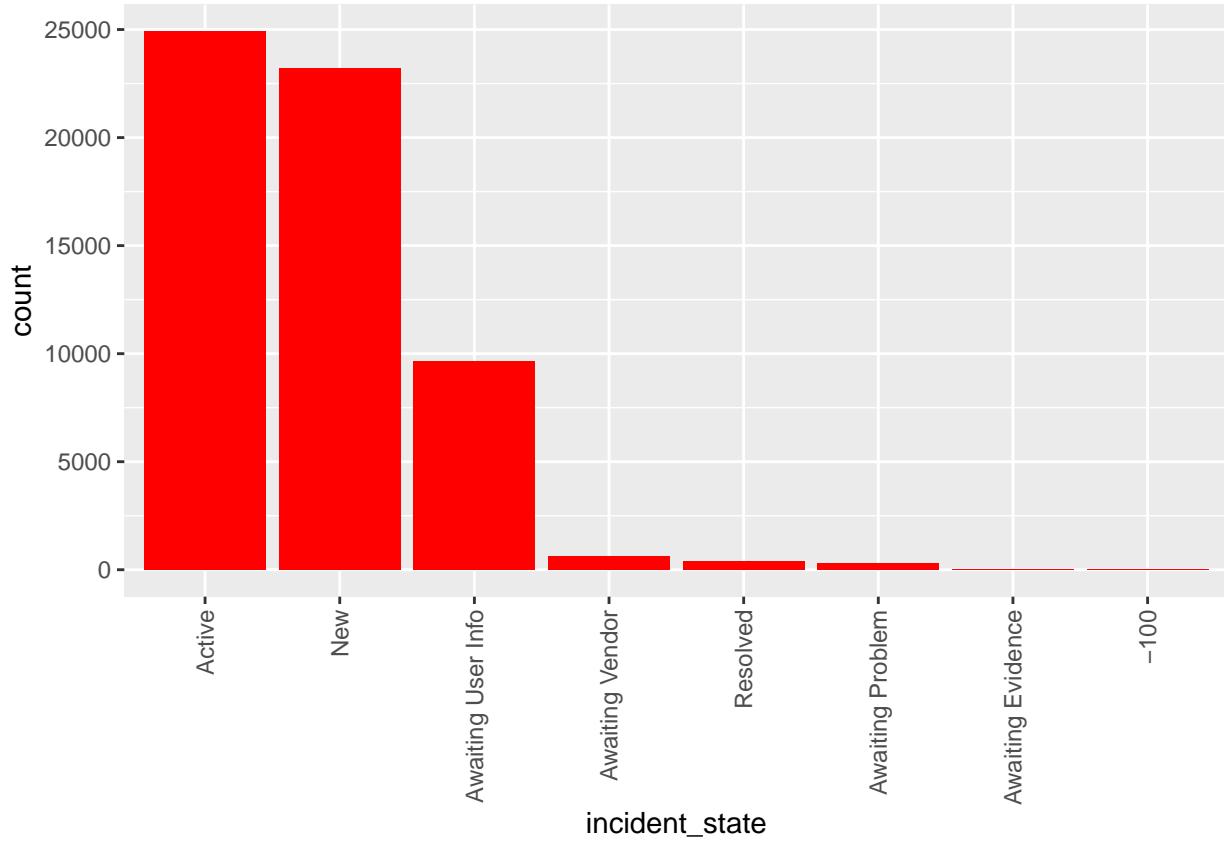
```
ggplot(incident_log, aes(x=reorder(subcategory, subcategory, function(x)-length(x)))) +  
  geom_bar(fill='red') +  labs(x='subcategory')
```



```
ggplot(incident_log, aes(x=reorder(made_sla, made_sla, function(x)-length(x)))) +  
  geom_bar(fill='red') +  labs(x='made_sla')
```

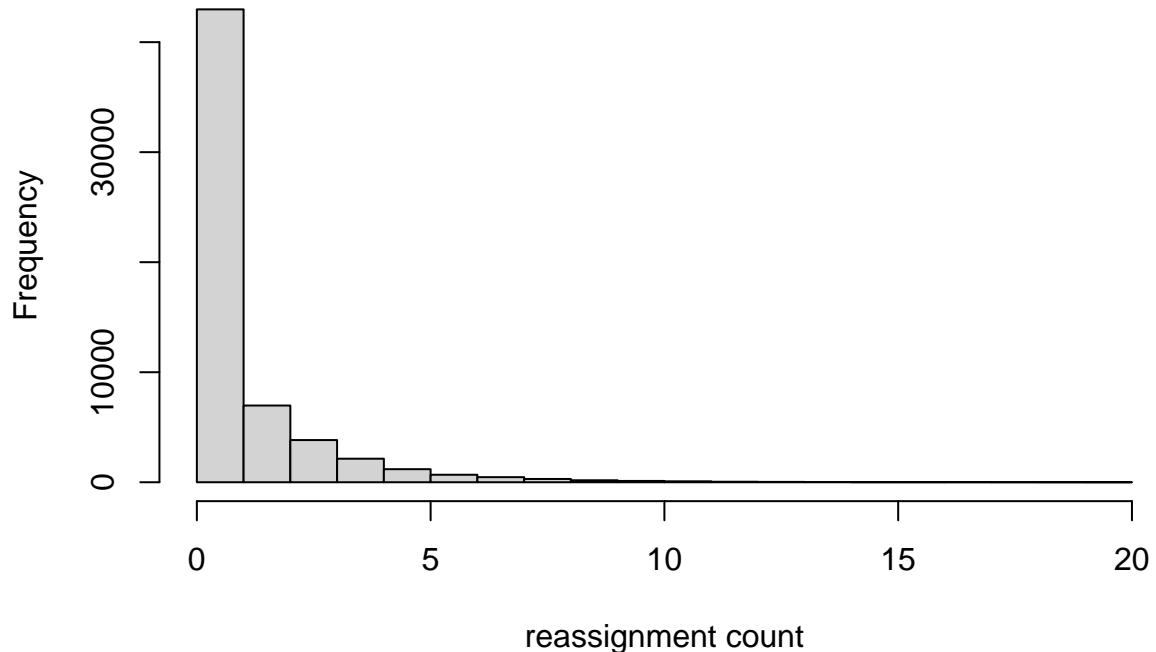


```
ggplot(incident_log, aes(x=reorder(incident_state, incident_state, function(x)-length(x)))) +  
  geom_bar(fill='red') +  labs(x='incident_state')+theme(axis.text.x = element_text(angle = 90, vjust = 0))
```



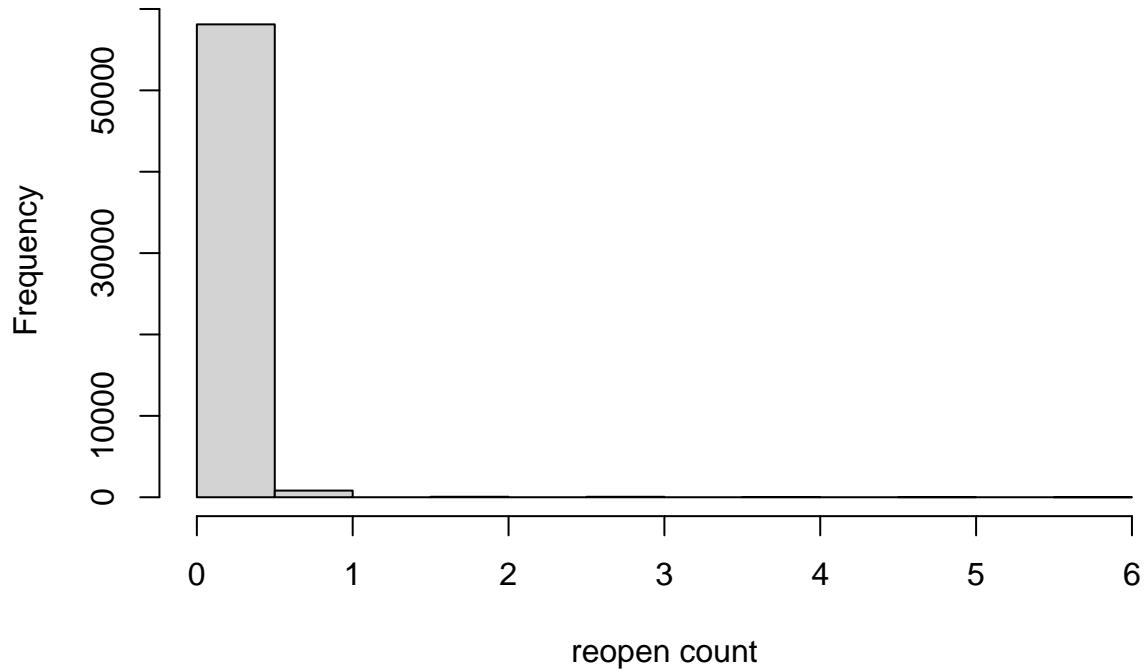
```
hist(incident_log$reassignment_count, xlab = "reassignment count", main = "Histogram of Reassignment Count")
```

## Histogram of Reassignment Count



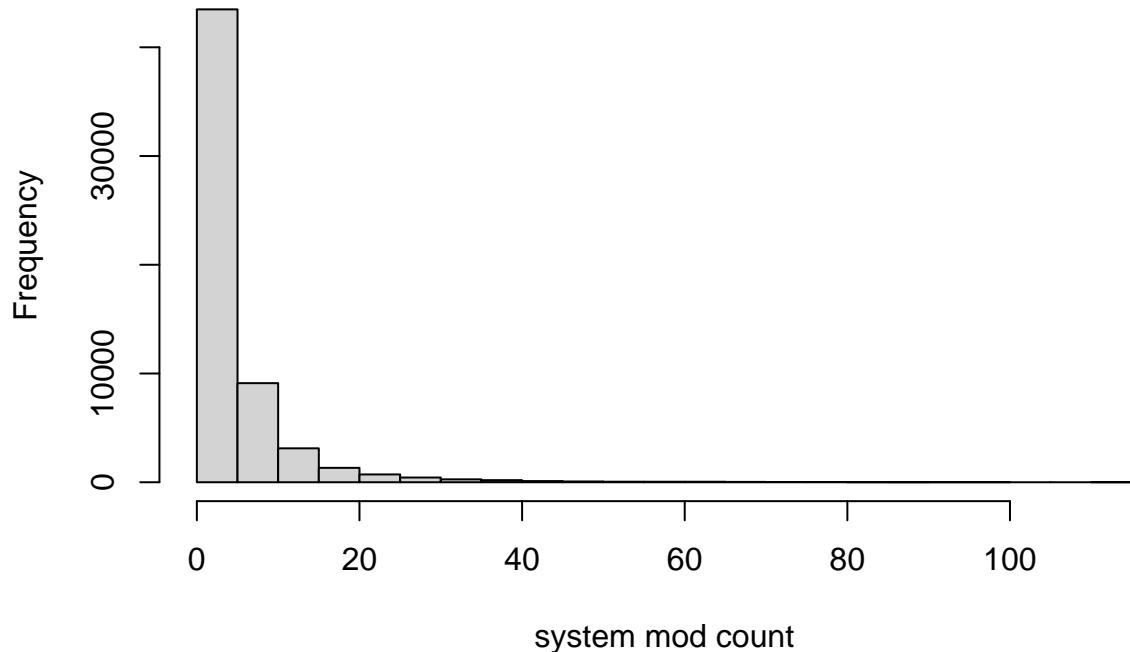
```
hist(incident_log$reopen_count, xlab = "reopen count", main = "Histogram of Reopen Count")
```

## Histogram of Reopen Count



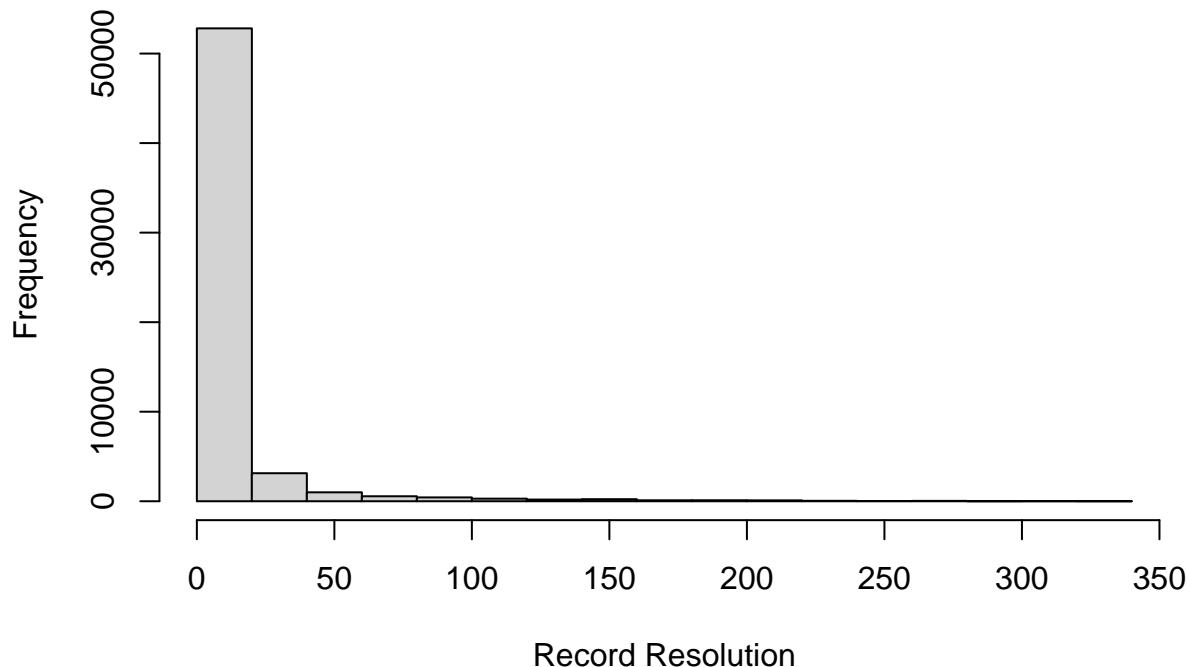
```
hist(incident_log$sys_mod_count, xlab = "system mod count" , main = "Histogram of Sys Mod Count")
```

## Histogram of Sys Mod Count



```
hist(incident_log$time_diff_res_update, xlab = "Record Resolution" , main = "Histogram of Length of Record Resolution Time Difference")
```

## Histogram of Length of Record Resolution



```
print("total number of records where reassignment_count and reopen_count is 0")  
  
## [1] "total number of records where reassignment_count and reopen_count is 0"  
  
length(intersect(which(incident_log$reassignment_count==0), which(incident_log$reopen_count==0)))  
  
## [1] 25284  
  
print("total number of records where reassignment_count is 0")  
  
## [1] "total number of records where reassignment_count is 0"  
  
length(which(incident_log$reassignment_count==0))  
  
## [1] 25524  
  
print("total number of records where reopen_count is 0")  
  
## [1] "total number of records where reopen_count is 0"
```

```

length(which(incident_log$reopen_count==0))

## [1] 58111

print("total number of records where urgency and impact are both 2 - Medium")

## [1] "total number of records where urgency and impact are both 2 - Medium"

length(intersect(which(incident_log$urgency=="2 - Medium"), which(incident_log$impact=="2 - Medium")))

## [1] 55087

print("total number of records where urgency is 2 - Medium")

## [1] "total number of records where urgency is 2 - Medium"

length(which(incident_log$urgency=="2 - Medium"))

## [1] 55848

print("total number of records where impact is 2 - Medium")

## [1] "total number of records where impact is 2 - Medium"

length(which(incident_log$impact=="2 - Medium"))

## [1] 56025

```

## Data Split

```

train_idx <- createDataPartition(incident_log$time_diff_res_update, p = 0.9, list=F)
df_train <- incident_log[train_idx,]
df_test <- incident_log[-train_idx,]
df_test<-subset(df_test, df_test$subcategory %in% unique(df_train$subcategory))
df_test<-subset(df_test, df_test$category %in% unique(df_train$category))

```

## Data train regression model

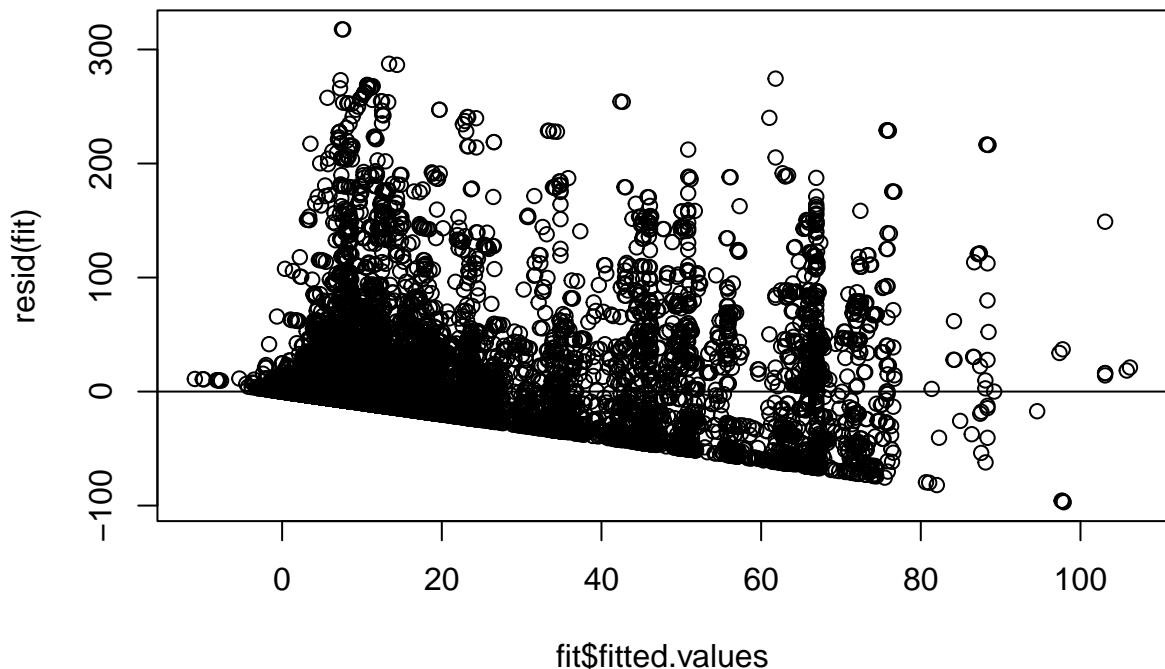
```

best1<-regsubsets(time_diff_res_update~category+subcategory+incident_state+reassignment_count+reopen_c
## Warning in leaps.setup(x, y, wt = wt, nbest = nbest, nvmax = nvmax, force.in =
## force.in, : 8 linear dependencies found
## Reordering variables and trying again:

```

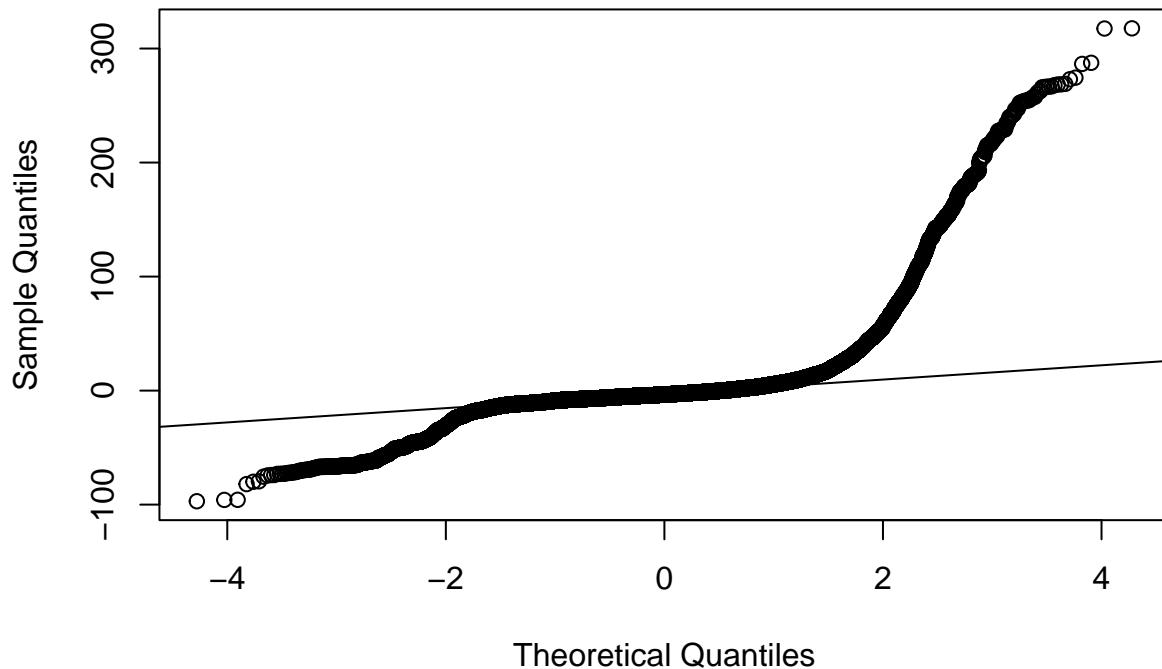
```
report1<-summary(best1)

fit<-lm(time_diff_res_update ~ category+subcategory+incident_state+reassignment_count+reopen_count+sys_r
```



```
qqnorm(residuals(fit))
qqline(residuals(fit))
```

## Normal Q-Q Plot



```

anova(fit)

## Analysis of Variance Table
##
## Response: time_diff_res_update
##                               Df  Sum Sq Mean Sq F value    Pr(>F)
## category                  55 4580413  83280 158.2629 < 2.2e-16 ***
## subcategory                218 2103611   9650  18.3377 < 2.2e-16 ***
## incident_state               7   70485  10069  19.1353 < 2.2e-16 ***
## reassignment_count            1     157     157  0.2978   0.5853
## reopen_count                 1       0       0  0.0007   0.9793
## sys_mod_count                1   22775   22775 43.2801 4.788e-11 ***
## made_sla                      1   1389   1389  2.6403   0.1042
## impact                         2   18829   9415 17.8911 1.708e-08 ***
## urgency                        2   16930   8465 16.0869 1.037e-07 ***
## priority                       3   24014   8005 15.2119 6.843e-10 ***
## Residuals                     52888 27830433    526
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(fit)

##
## Call:
## lm(formula = time_diff_res_update ~ category + subcategory +

```

```

##      incident_state + reassignment_count + reopen_count + sys_mod_count +
##      made_sla + impact + urgency + priority, data = df_train)
##
## Residuals:
##      Min     1Q Median     3Q    Max
## -97.03  -7.08 -3.47   1.37 317.70
##
## Coefficients: (8 not defined because of singularities)
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 8.11148  31.60991  0.257 0.797479
## categoryCategory 12        -13.59278  37.03399 -0.367 0.713594
## categoryCategory 13        -17.73710  18.00101 -0.985 0.324462
## categoryCategory 14        -11.93658  31.94807 -0.374 0.708685
## categoryCategory 15        -22.60163  22.24174 -1.016 0.309548
## categoryCategory 16        -15.84375  33.29274 -0.476 0.634153
## categoryCategory 17        -13.27605  17.99284 -0.738 0.460608
## categoryCategory 19        -14.57166  17.95831 -0.811 0.417130
## categoryCategory 2          -4.43307  29.29883 -0.151 0.879735
## categoryCategory 20        -18.82355  17.86733 -1.054 0.292108
## categoryCategory 21        -13.71880  29.67082 -0.462 0.643820
## categoryCategory 22        -17.02396  19.13320 -0.890 0.373599
## categoryCategory 23        -14.01933  17.84686 -0.786 0.432144
## categoryCategory 24        -9.68242  17.84315 -0.543 0.587379
## categoryCategory 25         14.05407  11.05304  1.272 0.203552
## categoryCategory 26        -17.44319  17.84537 -0.977 0.328344
## categoryCategory 27        -21.35214  24.10786 -0.886 0.375787
## categoryCategory 28        -14.18718  17.86108 -0.794 0.427020
## categoryCategory 29        -36.33083  17.97315 -2.021 0.043244 *
## categoryCategory 3          -52.20166  28.63369 -1.823 0.068296 .
## categoryCategory 30        -17.17645  19.26763 -0.891 0.372683
## categoryCategory 31         10.13233  11.55586  0.877 0.380592
## categoryCategory 32        -18.75301  17.86326 -1.050 0.293811
## categoryCategory 33        -21.14657  17.52049 -1.207 0.227452
## categoryCategory 34         23.87735  17.86163  1.337 0.181295
## categoryCategory 35        -18.06169  18.04402 -1.001 0.316841
## categoryCategory 37        -11.55748  17.85932 -0.647 0.517544
## categoryCategory 38        -9.65359  18.02067 -0.536 0.592172
## categoryCategory 4          -49.94888  23.59620 -2.117 0.034280 *
## categoryCategory 40        -15.48435  17.91106 -0.865 0.387310
## categoryCategory 41        -50.31171  20.03222 -2.512 0.012024 *
## categoryCategory 42        -9.64016  17.83785 -0.540 0.588901
## categoryCategory 43        -17.09602  18.02975 -0.948 0.343026
## categoryCategory 44        -18.92011  17.86676 -1.059 0.289625
## categoryCategory 45        -4.93865  17.83304 -0.277 0.781828
## categoryCategory 46        -10.57273  17.83550 -0.593 0.553323
## categoryCategory 47        -10.41594  18.27923 -0.570 0.568800
## categoryCategory 48        -7.51530  23.96658 -0.314 0.753846
## categoryCategory 49         2.29698  33.29274  0.069 0.944995
## categoryCategory 50        -48.86372  31.16678 -1.568 0.116931
## categoryCategory 51        -19.95613  17.86491 -1.117 0.263975
## categoryCategory 52        -52.49327  20.62067 -2.546 0.010910 *
## categoryCategory 53        -16.44446  17.83946 -0.922 0.356636
## categoryCategory 54        -43.33635  17.79128 -2.436 0.014861 *
## categoryCategory 55        -2.99429  17.91438 -0.167 0.867257

```

## categoryCategory 56	-33.56836	18.06928	-1.858	0.063209	.
## categoryCategory 57	-15.64676	17.86655	-0.876	0.381166	
## categoryCategory 59	-43.36425	21.66298	-2.002	0.045315	*
## categoryCategory 6	-6.22195	37.03399	-0.168	0.866579	
## categoryCategory 61	-2.88439	17.94242	-0.161	0.872285	
## categoryCategory 62	-9.07309	31.25985	-0.290	0.771628	
## categoryCategory 63	-17.74748	20.57716	-0.862	0.388425	
## categoryCategory 7	-8.87312	18.08806	-0.491	0.623746	
## categoryCategory 8	-9.76484	18.85974	-0.518	0.604627	
## categoryCategory 9	-14.51172	17.84161	-0.813	0.416013	
## categoryNone	8.02576	29.59062	0.271	0.786218	
## subcategorySubcategory 10	36.00851	34.30019	1.050	0.293813	
## subcategorySubcategory 101	-6.01147	24.19246	-0.248	0.803760	
## subcategorySubcategory 102	17.98217	25.72123	0.699	0.484482	
## subcategorySubcategory 103	6.62464	23.01081	0.288	0.773430	
## subcategorySubcategory 104	-0.47022	10.04303	-0.047	0.962656	
## subcategorySubcategory 105	7.53364	23.21800	0.324	0.745580	
## subcategorySubcategory 106	2.25813	23.18431	0.097	0.922410	
## subcategorySubcategory 107	13.45251	23.14802	0.581	0.561141	
## subcategorySubcategory 109	8.23389	23.42368	0.352	0.725200	
## subcategorySubcategory 11	3.01380	24.59016	0.123	0.902455	
## subcategorySubcategory 110	3.67226	23.04550	0.159	0.873395	
## subcategorySubcategory 111	8.07010	25.94297	0.311	0.755748	
## subcategorySubcategory 112	-4.82824	23.01926	-0.210	0.833865	
## subcategorySubcategory 113	8.00529	23.25740	0.344	0.730694	
## subcategorySubcategory 114	4.74456	23.04986	0.206	0.836918	
## subcategorySubcategory 115	76.65741	24.09664	3.181	0.001467	**
## subcategorySubcategory 116	5.10772	28.11589	0.182	0.855845	
## subcategorySubcategory 117	3.10477	23.00687	0.135	0.892652	
## subcategorySubcategory 118	5.92542	23.52431	0.252	0.801131	
## subcategorySubcategory 12	-1.33244	26.61333	-0.050	0.960069	
## subcategorySubcategory 120	2.14162	23.23124	0.092	0.926550	
## subcategorySubcategory 123	4.48199	22.99850	0.195	0.845486	
## subcategorySubcategory 125	7.06506	23.00835	0.307	0.758795	
## subcategorySubcategory 126	NA	NA	NA	NA	
## subcategorySubcategory 127	3.92993	23.16203	0.170	0.865269	
## subcategorySubcategory 129	54.51452	27.38461	1.991	0.046519	*
## subcategorySubcategory 13	2.73344	23.08429	0.118	0.905742	
## subcategorySubcategory 130	6.07827	23.11721	0.263	0.792603	
## subcategorySubcategory 131	NA	NA	NA	NA	
## subcategorySubcategory 132	9.68304	23.28583	0.416	0.677533	
## subcategorySubcategory 134	11.16694	23.00769	0.485	0.627425	
## subcategorySubcategory 135	6.92656	22.98729	0.301	0.763171	
## subcategorySubcategory 138	7.66336	28.15305	0.272	0.785467	
## subcategorySubcategory 140	1.31463	25.15230	0.052	0.958316	
## subcategorySubcategory 141	7.72750	32.49126	0.238	0.812011	
## subcategorySubcategory 142	9.45601	23.83166	0.397	0.691529	
## subcategorySubcategory 144	-3.07945	23.91736	-0.129	0.897553	
## subcategorySubcategory 145	8.03596	23.02731	0.349	0.727109	
## subcategorySubcategory 146	7.75883	23.05537	0.337	0.736472	
## subcategorySubcategory 149	-12.30076	25.75566	-0.478	0.632941	
## subcategorySubcategory 150	13.64665	22.98571	0.594	0.552714	
## subcategorySubcategory 151	-35.39975	23.07662	-1.534	0.125033	
## subcategorySubcategory 152	12.09360	26.38868	0.458	0.646748	

## subcategorySubcategory 153	6.41094	23.02727	0.278	0.780701
## subcategorySubcategory 154	27.21072	22.99625	1.183	0.236708
## subcategorySubcategory 155	16.37948	25.10740	0.652	0.514161
## subcategorySubcategory 156	-4.37971	24.41301	-0.179	0.857624
## subcategorySubcategory 157	-1.04009	32.46110	-0.032	0.974439
## subcategorySubcategory 158	-23.47400	29.12373	-0.806	0.420241
## subcategorySubcategory 159	8.03935	23.11922	0.348	0.728041
## subcategorySubcategory 16	-5.03480	23.32200	-0.216	0.829080
## subcategorySubcategory 160	17.77419	32.90155	0.540	0.589045
## subcategorySubcategory 161	-8.38442	23.92196	-0.350	0.725972
## subcategorySubcategory 162	-32.56485	23.43527	-1.390	0.164667
## subcategorySubcategory 163	16.43917	23.09853	0.712	0.476655
## subcategorySubcategory 164	6.80661	22.96772	0.296	0.766960
## subcategorySubcategory 165	NA	NA	NA	NA
## subcategorySubcategory 166	0.27921	23.87372	0.012	0.990669
## subcategorySubcategory 167	0.25310	23.87623	0.011	0.991542
## subcategorySubcategory 168	8.83528	23.01021	0.384	0.701000
## subcategorySubcategory 169	11.22406	23.90100	0.470	0.638638
## subcategorySubcategory 17	3.38941	24.02719	0.141	0.887819
## subcategorySubcategory 170	5.27800	23.02325	0.229	0.818678
## subcategorySubcategory 171	52.17081	23.77653	2.194	0.028224 *
## subcategorySubcategory 172	12.26088	23.34331	0.525	0.599417
## subcategorySubcategory 174	6.37671	22.96094	0.278	0.781229
## subcategorySubcategory 175	7.40399	22.97241	0.322	0.747227
## subcategorySubcategory 176	-14.53491	30.24886	-0.481	0.630866
## subcategorySubcategory 177	38.12337	23.48660	1.623	0.104553
## subcategorySubcategory 178	6.26844	23.13776	0.271	0.786455
## subcategorySubcategory 179	0.72043	32.45982	0.022	0.982293
## subcategorySubcategory 18	3.69596	24.54713	0.151	0.880319
## subcategorySubcategory 181	-3.26702	23.16247	-0.141	0.887833
## subcategorySubcategory 182	12.09089	23.13923	0.523	0.601305
## subcategorySubcategory 183	-0.70531	23.04688	-0.031	0.975586
## subcategorySubcategory 184	3.14678	23.08237	0.136	0.891562
## subcategorySubcategory 185	2.36023	23.03833	0.102	0.918402
## subcategorySubcategory 186	26.91251	26.22696	1.026	0.304831
## subcategorySubcategory 189	0.08401	23.10180	0.004	0.997099
## subcategorySubcategory 191	13.41415	23.04908	0.582	0.560581
## subcategorySubcategory 192	NA	NA	NA	NA
## subcategorySubcategory 193	18.32357	25.37640	0.722	0.470254
## subcategorySubcategory 194	2.84442	23.59339	0.121	0.904040
## subcategorySubcategory 197	-23.86850	23.36010	-1.022	0.306897
## subcategorySubcategory 198	4.12771	23.18205	0.178	0.858680
## subcategorySubcategory 199	4.92113	24.00492	0.205	0.837569
## subcategorySubcategory 2	4.68865	26.58558	0.176	0.860011
## subcategorySubcategory 20	9.80403	23.09771	0.424	0.671233
## subcategorySubcategory 200	0.79538	23.01647	0.035	0.972433
## subcategorySubcategory 202	8.72211	23.00020	0.379	0.704527
## subcategorySubcategory 203	8.36233	25.88829	0.323	0.746685
## subcategorySubcategory 204	-1.05050	32.46110	-0.032	0.974184
## subcategorySubcategory 205	-38.74065	24.09970	-1.608	0.107947
## subcategorySubcategory 207	93.06362	23.92584	3.890	0.000101 ***
## subcategorySubcategory 208	2.36401	23.17542	0.102	0.918753
## subcategorySubcategory 209	2.36210	24.32320	0.097	0.922637
## subcategorySubcategory 210	27.70012	28.85098	0.960	0.337004

## subcategorySubcategory 211	1.41661	28.15259	0.050	0.959868
## subcategorySubcategory 212	-5.17492	32.46481	-0.159	0.873354
## subcategorySubcategory 215	4.59605	23.08200	0.199	0.842171
## subcategorySubcategory 216	2.64420	24.41985	0.108	0.913773
## subcategorySubcategory 217	4.90770	24.84727	0.198	0.843426
## subcategorySubcategory 218	8.92711	23.25423	0.384	0.701060
## subcategorySubcategory 219	9.44799	23.37252	0.404	0.686042
## subcategorySubcategory 220	-2.23169	23.60119	-0.095	0.924666
## subcategorySubcategory 223	2.17082	22.97322	0.094	0.924718
## subcategorySubcategory 224	2.00676	23.02441	0.087	0.930546
## subcategorySubcategory 225	37.90361	25.15270	1.507	0.131832
## subcategorySubcategory 226	1.97429	23.98412	0.082	0.934395
## subcategorySubcategory 228	-0.12588	23.04694	-0.005	0.995642
## subcategorySubcategory 229	5.14141	23.02110	0.223	0.823276
## subcategorySubcategory 23	3.48651	23.50183	0.148	0.882067
## subcategorySubcategory 230	31.99752	23.45910	1.364	0.172583
## subcategorySubcategory 231	11.97829	22.99651	0.521	0.602457
## subcategorySubcategory 232	8.01168	23.85203	0.336	0.736955
## subcategorySubcategory 233	3.26685	23.10049	0.141	0.887539
## subcategorySubcategory 235	33.13937	23.80247	1.392	0.163848
## subcategorySubcategory 236	-10.57183	32.47546	-0.326	0.744779
## subcategorySubcategory 240	26.83286	23.42364	1.146	0.251988
## subcategorySubcategory 241	-9.90899	32.47552	-0.305	0.760275
## subcategorySubcategory 242	5.07470	23.08421	0.220	0.826001
## subcategorySubcategory 243	3.85846	23.10793	0.167	0.867390
## subcategorySubcategory 244	-1.21155	23.51098	-0.052	0.958902
## subcategorySubcategory 245	19.48271	23.31666	0.836	0.403400
## subcategorySubcategory 246	4.41329	23.35117	0.189	0.850096
## subcategorySubcategory 247	8.67902	23.08255	0.376	0.706919
## subcategorySubcategory 248	8.12720	23.02207	0.353	0.724076
## subcategorySubcategory 249	21.26921	23.04358	0.923	0.356012
## subcategorySubcategory 25	9.15621	23.07235	0.397	0.691481
## subcategorySubcategory 250	3.32138	23.12053	0.144	0.885774
## subcategorySubcategory 251	7.18576	22.99043	0.313	0.754620
## subcategorySubcategory 252	16.90835	23.09272	0.732	0.464054
## subcategorySubcategory 253	-8.76588	23.74634	-0.369	0.712020
## subcategorySubcategory 254	2.50535	23.24956	0.108	0.914187
## subcategorySubcategory 255	7.43161	23.00902	0.323	0.746707
## subcategorySubcategory 256	-0.95471	23.51112	-0.041	0.967610
## subcategorySubcategory 257	22.23762	23.15010	0.961	0.336766
## subcategorySubcategory 258	0.90725	23.10322	0.039	0.968676
## subcategorySubcategory 259	2.39516	23.02271	0.104	0.917142
## subcategorySubcategory 260	17.69641	23.15583	0.764	0.444733
## subcategorySubcategory 261	11.45804	23.15583	0.495	0.620727
## subcategorySubcategory 262	-0.48174	23.73773	-0.020	0.983809
## subcategorySubcategory 264	78.31045	32.47552	2.411	0.015896 *
## subcategorySubcategory 269	5.84771	32.47402	0.180	0.857096
## subcategorySubcategory 270	7.93584	23.08507	0.344	0.731024
## subcategorySubcategory 271	4.32962	23.05635	0.188	0.851047
## subcategorySubcategory 273	13.25271	23.67267	0.560	0.575597
## subcategorySubcategory 274	0.84200	25.15272	0.033	0.973295
## subcategorySubcategory 275	6.88075	22.97755	0.299	0.764594
## subcategorySubcategory 276	-9.85011	37.57695	-0.262	0.793221
## subcategorySubcategory 277	7.24083	24.08786	0.301	0.763720

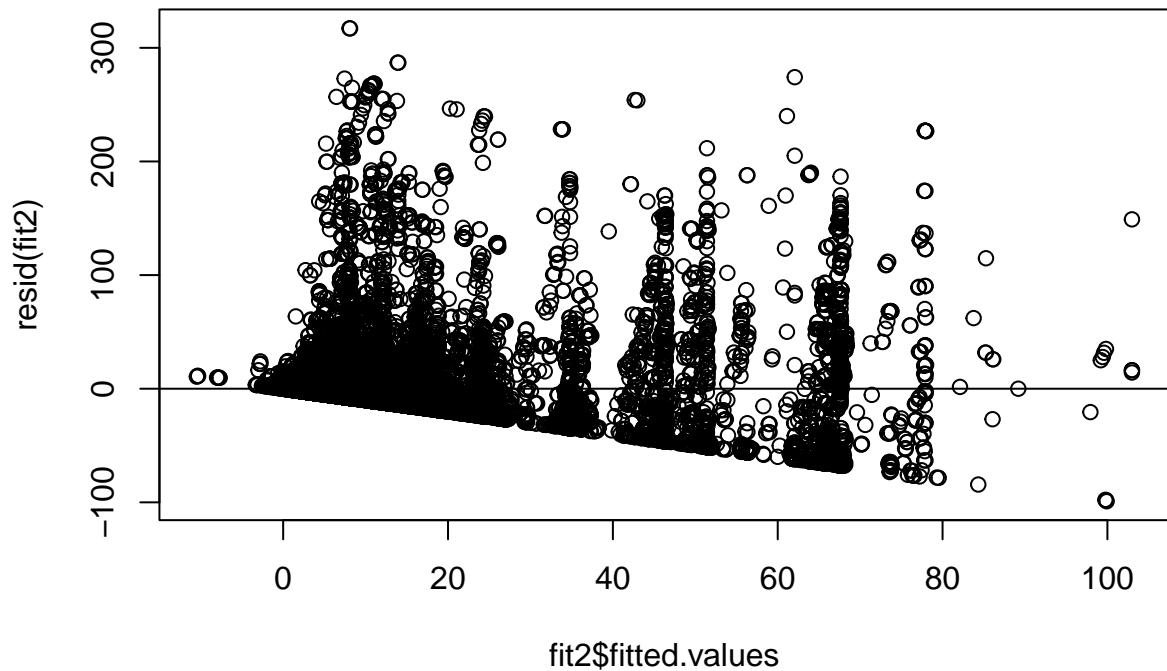
## subcategorySubcategory 279	4.76387	26.51079	0.180	0.857392
## subcategorySubcategory 28	5.55676	23.17512	0.240	0.810508
## subcategorySubcategory 281	-0.57453	23.93812	-0.024	0.980852
## subcategorySubcategory 282	48.75394	29.83185	1.634	0.102204
## subcategorySubcategory 285	-0.38854	23.10918	-0.017	0.986586
## subcategorySubcategory 287	3.54811	23.90333	0.148	0.882000
## subcategorySubcategory 289	8.12150	23.20094	0.350	0.726302
## subcategorySubcategory 29	2.20239	22.99436	0.096	0.923696
## subcategorySubcategory 291	-1.48392	24.67280	-0.060	0.952041
## subcategorySubcategory 292	14.04591	24.43857	0.575	0.565467
## subcategorySubcategory 294	16.15536	23.23351	0.695	0.486841
## subcategorySubcategory 295	20.32781	24.96044	0.814	0.415419
## subcategorySubcategory 296	2.52165	23.82706	0.106	0.915716
## subcategorySubcategory 298	1.24487	28.11589	0.044	0.964684
## subcategorySubcategory 299	-2.84176	23.78427	-0.119	0.904895
## subcategorySubcategory 3	4.40905	22.98984	0.192	0.847913
## subcategorySubcategory 30	13.66848	23.11129	0.591	0.554242
## subcategorySubcategory 300	6.74259	23.01592	0.293	0.769559
## subcategorySubcategory 301	8.87705	23.14705	0.384	0.701346
## subcategorySubcategory 302	6.19422	23.12679	0.268	0.788825
## subcategorySubcategory 303	5.25897	22.98209	0.229	0.819003
## subcategorySubcategory 305	63.37348	23.09477	2.744	0.006070 **
## subcategorySubcategory 31	8.20660	22.99790	0.357	0.721212
## subcategorySubcategory 32	4.81325	24.44486	0.197	0.843905
## subcategorySubcategory 35	-4.01401	28.12470	-0.143	0.886510
## subcategorySubcategory 36	-4.55324	23.07114	-0.197	0.843549
## subcategorySubcategory 37	17.69669	24.96105	0.709	0.478345
## subcategorySubcategory 4	1.25757	23.28385	0.054	0.956927
## subcategorySubcategory 40	4.44846	24.96158	0.178	0.858557
## subcategorySubcategory 42	68.15042	23.22040	2.935	0.003338 **
## subcategorySubcategory 43	7.84522	23.03305	0.341	0.733401
## subcategorySubcategory 44	5.03076	23.04432	0.218	0.827190
## subcategorySubcategory 45	NA	NA	NA	NA
## subcategorySubcategory 46	0.08873	28.12640	0.003	0.997483
## subcategorySubcategory 47	51.78383	23.08955	2.243	0.024918 *
## subcategorySubcategory 48	11.82435	24.13665	0.490	0.624213
## subcategorySubcategory 50	4.77000	23.43717	0.204	0.838727
## subcategorySubcategory 51	-6.98334	24.57894	-0.284	0.776320
## subcategorySubcategory 52	1.09707	23.98535	0.046	0.963518
## subcategorySubcategory 53	36.01268	34.30019	1.050	0.293757
## subcategorySubcategory 54	11.18749	23.09511	0.484	0.628097
## subcategorySubcategory 56	13.40873	24.59042	0.545	0.585561
## subcategorySubcategory 57	6.23147	23.29498	0.268	0.789083
## subcategorySubcategory 59	10.00134	23.10103	0.433	0.665061
## subcategorySubcategory 6	17.67325	23.15515	0.763	0.445316
## subcategorySubcategory 60	9.62901	23.10054	0.417	0.676804
## subcategorySubcategory 62	24.90222	26.54974	0.938	0.348277
## subcategorySubcategory 64	13.84051	23.09129	0.599	0.548921
## subcategorySubcategory 65	11.66111	23.20711	0.502	0.615332
## subcategorySubcategory 66	5.01508	24.39795	0.206	0.837141
## subcategorySubcategory 68	37.44718	23.62926	1.585	0.113022
## subcategorySubcategory 69	2.93381	23.07241	0.127	0.898817
## subcategorySubcategory 71	NA	NA	NA	NA
## subcategorySubcategory 72	9.83795	23.09132	0.426	0.670077

```

## subcategorySubcategory 74      5.44397  23.38684  0.233 0.815934
## subcategorySubcategory 75      4.88408  22.98555  0.212 0.831730
## subcategorySubcategory 77     -5.69773  25.15495 -0.227 0.820809
## subcategorySubcategory 78      8.47678  23.66972  0.358 0.720249
## subcategorySubcategory 8       NA        NA        NA        NA
## subcategorySubcategory 80      8.70353  23.03695  0.378 0.705575
## subcategorySubcategory 82      3.60178  23.08001  0.156 0.875989
## subcategorySubcategory 83      1.38925  24.20450  0.057 0.954230
## subcategorySubcategory 85     14.21987  24.02736  0.592 0.553974
## subcategorySubcategory 86      2.54143  23.17937  0.110 0.912694
## subcategorySubcategory 87      NA        NA        NA        NA
## subcategorySubcategory 88     19.07482  23.00778  0.829 0.407074
## subcategorySubcategory 89      6.79150  23.25123  0.292 0.770217
## subcategorySubcategory 9       8.79560  22.99673  0.382 0.702113
## subcategorySubcategory 90     12.56112  23.33197  0.538 0.590327
## subcategorySubcategory 92      7.37098  23.47699  0.314 0.753548
## subcategorySubcategory 94      9.70082  23.00316  0.422 0.673233
## subcategorySubcategory 95    -10.00422  32.47512 -0.308 0.758040
## subcategorySubcategory 96      36.91974  24.09273  1.532 0.125429
## subcategorySubcategory 97      0.36734  28.11732  0.013 0.989576
## subcategorySubcategory 99    -1.73427  26.61392 -0.065 0.948044
## incident_stateActive        9.98533  11.48901  0.869 0.384785
## incident_stateAwaiting Evidence 21.83267  12.30542  1.774 0.076030 .
## incident_stateAwaiting Problem 22.47353  11.57270  1.942 0.052149 .
## incident_stateAwaiting User Info 10.80301  11.49003  0.940 0.347115
## incident_stateAwaiting Vendor 19.08052  11.53998  1.653 0.098250 .
## incident_stateNew           10.84080  11.48954  0.944 0.345411
## incident_stateResolved      8.03425  11.55465  0.695 0.486854
## reassignment_count          0.28770  0.07236  3.976 7.02e-05 ***
## reopen_count                 0.83624  0.58405  1.432 0.152213
## sys_mod_count                -0.13299  0.02043 -6.509 7.63e-11 ***
## made_slatrue                  -7.37845  4.47816 -1.648 0.099430 .
## impact2 - Medium            -10.20448  9.26957 -1.101 0.270964
## impact3 - Low                 -22.98278 10.49627 -2.190 0.028557 *
## urgency2 - Medium            -7.65042  9.16963 -0.834 0.404103
## urgency3 - Low                 -16.03041  9.41687 -1.702 0.088704 .
## priority2 - High              9.50726  9.26045  1.027 0.304589
## priority3 - Moderate         22.09955  18.40445  1.201 0.229845
## priority4 - Low               43.76044  19.55719  2.238 0.025254 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 22.94 on 52888 degrees of freedom
## Multiple R-squared:  0.1973, Adjusted R-squared:  0.1928
## F-statistic: 44.66 on 291 and 52888 DF,  p-value: < 2.2e-16

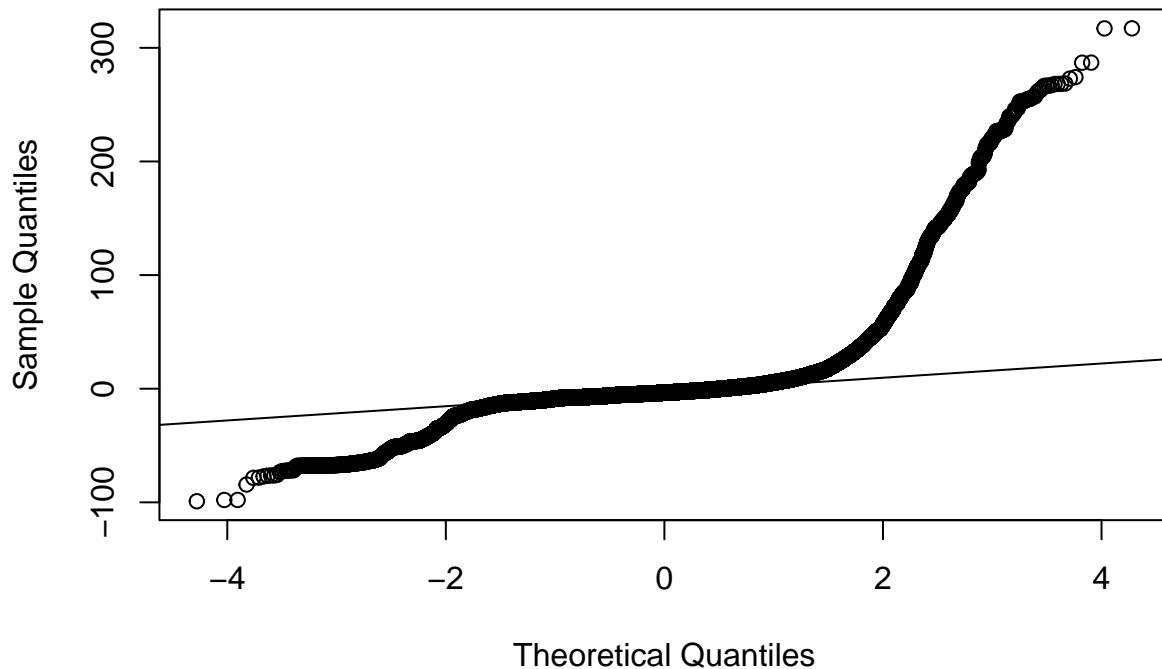
fit2<-lm(time_diff_res_update ~ category+subcategory+reassignment_count+reopen_count+sys_mod_count+made
plot(fit2$fitted.values,resid(fit2))
abline(0,0)

```



```
qqnorm(residuals(fit2))
qqline(residuals(fit2))
```

## Normal Q-Q Plot



```
anova(fit2)
```

```
## Analysis of Variance Table
##
## Response: time_diff_res_update
##             Df  Sum Sq Mean Sq F value    Pr(>F)
## category      55 4580413  83280 157.8160 < 2.2e-16 ***
## subcategory   218 2103611   9650  18.2860 < 2.2e-16 ***
## reassignment_count 1     41     41  0.0783  0.7796
## reopen_count   1    140    140  0.2657  0.6062
## sys_mod_count  1   10121   10121 19.1789 1.193e-05 ***
## made_sla       1    1271   1271  2.4093  0.1206
## impact         2   18890   9445 17.8980 1.697e-08 ***
## urgency        2   17642   8821 16.7154 5.532e-08 ***
## priority       3   23976   7992 15.1450 7.549e-10 ***
## Residuals     52895 27912931    528
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(fit2)
```

```
##
## Call:
## lm(formula = time_diff_res_update ~ category + subcategory +
##     reassignment_count + reopen_count + sys_mod_count + made_sla +
```

```

##      impact + urgency + priority, data = df_train)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -99.04  -7.11  -3.49   1.34 317.14
##
## Coefficients: (8 not defined because of singularities)
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 16.45892  29.46503  0.559 0.576443
## categoryCategory 12        -11.44989  37.08547 -0.309 0.757518
## categoryCategory 13        -16.45960  18.02593 -0.913 0.361191
## categoryCategory 14        -10.04090  31.99253 -0.314 0.753635
## categoryCategory 15        -21.17326  22.27259 -0.951 0.341791
## categoryCategory 16        -13.65884  33.33879 -0.410 0.682029
## categoryCategory 17        -12.12773  18.01785 -0.673 0.500890
## categoryCategory 19        -13.24210  17.98304 -0.736 0.461511
## categoryCategory 2          -1.86612  29.33827 -0.064 0.949283
## categoryCategory 20        -17.61032  17.89215 -0.984 0.324998
## categoryCategory 21        -11.70552  29.71180 -0.394 0.693606
## categoryCategory 22        -16.23332  19.15942 -0.847 0.396845
## categoryCategory 23        -12.80653  17.87166 -0.717 0.473635
## categoryCategory 24        -8.44276  17.86791 -0.473 0.636565
## categoryCategory 25        15.62628  11.06577  1.412 0.157918
## categoryCategory 26        -16.33740  17.87017 -0.914 0.360602
## categoryCategory 27        -20.64133  24.14130 -0.855 0.392543
## categoryCategory 28        -13.13569  17.88585 -0.734 0.462697
## categoryCategory 29        -33.72264  17.99493 -1.874 0.060935 .
## categoryCategory 3          -51.81618  28.67350 -1.807 0.070751 .
## categoryCategory 30        -15.83085  19.29428 -0.820 0.411938
## categoryCategory 31        10.19468  11.57218  0.881 0.378341
## categoryCategory 32        -17.56183  17.88807 -0.982 0.326222
## categoryCategory 33        -15.49446  17.52532 -0.884 0.376636
## categoryCategory 34        25.74420  17.88542  1.439 0.150044
## categoryCategory 35        -17.10439  18.06909 -0.947 0.343842
## categoryCategory 37        -10.37448  17.88410 -0.580 0.561853
## categoryCategory 38        -8.62094  18.04585 -0.478 0.632848
## categoryCategory 4          -49.56340  23.62874 -2.098 0.035946 *
## categoryCategory 40        -14.42383  17.93600 -0.804 0.421295
## categoryCategory 41        -48.98988  20.05998 -2.442 0.014603 *
## categoryCategory 42        -8.50994  17.86264 -0.476 0.633784
## categoryCategory 43        -16.06689  18.05483 -0.890 0.373527
## categoryCategory 44        -17.62823  17.89155 -0.985 0.324490
## categoryCategory 45        -3.70428  17.85786 -0.207 0.835674
## categoryCategory 46        -9.43814  17.86032 -0.528 0.597195
## categoryCategory 47        -9.10410  18.30453 -0.497 0.618931
## categoryCategory 48        -5.66643  23.99865 -0.236 0.813345
## categoryCategory 49        4.41276  33.33885  0.132 0.894699
## categoryCategory 50        -48.13234  31.21061 -1.542 0.123036
## categoryCategory 51        -19.16834  17.88955 -1.071 0.283957
## categoryCategory 52        -51.87291  20.64924 -2.512 0.012005 *
## categoryCategory 53        -15.34891  17.86428 -0.859 0.390237
## categoryCategory 54        -42.58605  17.81600 -2.390 0.016837 *
## categoryCategory 55        -1.13709  17.93903 -0.063 0.949459
## categoryCategory 56        -33.14914  18.09429 -1.832 0.066954 .

```

## categoryCategory 57	-14.47670	17.89141	-0.809	0.418437
## categoryCategory 59	-39.75226	21.68796	-1.833	0.066820 .
## categoryCategory 6	-4.07905	37.08547	-0.110	0.912417
## categoryCategory 61	-1.79355	17.96736	-0.100	0.920485
## categoryCategory 62	-7.39944	31.30344	-0.236	0.813140
## categoryCategory 63	-16.85260	20.60585	-0.818	0.413444
## categoryCategory 7	-7.78628	18.11315	-0.430	0.667293
## categoryCategory 8	-8.64251	18.88603	-0.458	0.647232
## categoryCategory 9	-13.47512	17.86644	-0.754	0.450724
## categoryNone	9.45288	29.63175	0.319	0.749719
## subcategorySubcategory 10	36.82958	34.34844	1.072	0.283620
## subcategorySubcategory 101	-6.57303	24.22623	-0.271	0.786147
## subcategorySubcategory 102	18.19114	25.75738	0.706	0.480036
## subcategorySubcategory 103	7.17752	23.04302	0.311	0.755434
## subcategorySubcategory 104	-0.57775	10.05712	-0.057	0.954190
## subcategorySubcategory 105	8.30802	23.25050	0.357	0.720849
## subcategorySubcategory 106	3.08981	23.21652	0.133	0.894125
## subcategorySubcategory 107	14.34171	23.18033	0.619	0.536116
## subcategorySubcategory 109	9.81971	23.45633	0.419	0.675482
## subcategorySubcategory 11	3.66342	24.62459	0.149	0.881735
## subcategorySubcategory 110	4.34293	23.07780	0.188	0.850731
## subcategorySubcategory 111	8.96403	25.97912	0.345	0.730060
## subcategorySubcategory 112	-4.61403	23.05156	-0.200	0.841355
## subcategorySubcategory 113	8.66823	23.28989	0.372	0.709754
## subcategorySubcategory 114	5.36154	23.08214	0.232	0.816321
## subcategorySubcategory 115	75.29487	24.13006	3.120	0.001807 **
## subcategorySubcategory 116	5.70022	28.15551	0.202	0.839562
## subcategorySubcategory 117	3.64488	23.03918	0.158	0.874297
## subcategorySubcategory 118	6.15184	23.55695	0.261	0.793980
## subcategorySubcategory 12	-0.56163	26.65068	-0.021	0.983187
## subcategorySubcategory 120	2.61391	23.26377	0.112	0.910539
## subcategorySubcategory 123	5.13045	23.03072	0.223	0.823719
## subcategorySubcategory 125	7.74332	23.04049	0.336	0.736816
## subcategorySubcategory 126	NA	NA	NA	NA
## subcategorySubcategory 127	4.86786	23.19419	0.210	0.833767
## subcategorySubcategory 129	55.66984	27.42274	2.030	0.042355 *
## subcategorySubcategory 13	3.50765	23.11651	0.152	0.879394
## subcategorySubcategory 130	6.90146	23.14942	0.298	0.765608
## subcategorySubcategory 131	NA	NA	NA	NA
## subcategorySubcategory 132	10.37593	23.31828	0.445	0.656343
## subcategorySubcategory 134	11.99672	23.03985	0.521	0.602582
## subcategorySubcategory 135	7.58686	23.01948	0.330	0.741715
## subcategorySubcategory 138	8.63618	28.19232	0.306	0.759354
## subcategorySubcategory 140	1.90378	25.18762	0.076	0.939750
## subcategorySubcategory 141	7.84486	32.53705	0.241	0.809474
## subcategorySubcategory 142	9.41986	23.86506	0.395	0.693056
## subcategorySubcategory 144	-2.36443	23.95084	-0.099	0.921361
## subcategorySubcategory 145	8.85760	23.05946	0.384	0.700891
## subcategorySubcategory 146	8.23933	23.08775	0.357	0.721190
## subcategorySubcategory 149	-12.33738	25.79152	-0.478	0.632403
## subcategorySubcategory 150	14.31202	23.01778	0.622	0.534088
## subcategorySubcategory 151	-35.64721	23.10880	-1.543	0.122938
## subcategorySubcategory 152	8.33120	26.41594	0.315	0.752470
## subcategorySubcategory 153	7.08755	23.05951	0.307	0.758571

```

## subcategorySubcategory 154 28.20643 23.02831 1.225 0.220634
## subcategorySubcategory 155 14.31795 25.13550 0.570 0.568931
## subcategorySubcategory 156 -3.14988 24.44716 -0.129 0.897481
## subcategorySubcategory 157 0.06620 32.50640 0.002 0.998375
## subcategorySubcategory 158 -21.37382 29.16386 -0.733 0.463630
## subcategorySubcategory 159 8.99721 23.15150 0.389 0.697556
## subcategorySubcategory 16 -4.53823 23.35469 -0.194 0.845928
## subcategorySubcategory 160 19.49786 32.94759 0.592 0.553998
## subcategorySubcategory 161 -8.58383 23.95516 -0.358 0.720098
## subcategorySubcategory 162 -32.21536 23.46774 -1.373 0.169836
## subcategorySubcategory 163 17.03689 23.13083 0.737 0.461403
## subcategorySubcategory 164 7.54646 22.99988 0.328 0.742831
## subcategorySubcategory 165 NA NA NA NA
## subcategorySubcategory 166 0.50504 23.90733 0.021 0.983146
## subcategorySubcategory 167 1.04810 23.90962 0.044 0.965036
## subcategorySubcategory 168 9.59591 23.04236 0.416 0.677085
## subcategorySubcategory 169 12.33852 23.93391 0.516 0.606189
## subcategorySubcategory 17 3.60623 24.06067 0.150 0.880859
## subcategorySubcategory 170 5.94538 23.05544 0.258 0.796506
## subcategorySubcategory 171 53.40748 23.80973 2.243 0.024895 *
## subcategorySubcategory 172 12.74790 23.37617 0.545 0.585524
## subcategorySubcategory 174 6.99533 22.99312 0.304 0.760949
## subcategorySubcategory 175 8.07836 23.00460 0.351 0.725467
## subcategorySubcategory 176 -12.84620 30.29104 -0.424 0.671500
## subcategorySubcategory 177 39.02532 23.51941 1.659 0.097065 .
## subcategorySubcategory 178 6.92463 23.17009 0.299 0.765047
## subcategorySubcategory 179 1.76778 32.50518 0.054 0.956629
## subcategorySubcategory 18 4.58330 24.58141 0.186 0.852090
## subcategorySubcategory 181 -3.34340 23.19442 -0.144 0.885385
## subcategorySubcategory 182 12.84678 23.17128 0.554 0.579289
## subcategorySubcategory 183 0.05584 23.07903 0.002 0.998069
## subcategorySubcategory 184 3.84403 23.11466 0.166 0.867919
## subcategorySubcategory 185 2.92013 23.07063 0.127 0.899279
## subcategorySubcategory 186 28.32209 26.26323 1.078 0.280863
## subcategorySubcategory 189 0.85940 23.13417 0.037 0.970367
## subcategorySubcategory 191 14.51740 23.08121 0.629 0.529371
## subcategorySubcategory 192 NA NA NA NA
## subcategorySubcategory 193 19.52660 25.41187 0.768 0.442250
## subcategorySubcategory 194 3.88138 23.62600 0.164 0.869508
## subcategorySubcategory 197 -23.70644 23.39237 -1.013 0.310861
## subcategorySubcategory 198 4.72767 23.21451 0.204 0.838627
## subcategorySubcategory 199 5.41515 24.03850 0.225 0.821770
## subcategorySubcategory 2 5.84939 26.62225 0.220 0.826092
## subcategorySubcategory 20 10.31099 23.13018 0.446 0.655757
## subcategorySubcategory 200 1.56175 23.04851 0.068 0.945977
## subcategorySubcategory 202 9.25515 23.03248 0.402 0.687810
## subcategorySubcategory 203 9.73294 25.92366 0.375 0.707330
## subcategorySubcategory 204 0.05579 32.50640 0.002 0.998631
## subcategorySubcategory 205 -38.80763 24.13335 -1.608 0.107830
## subcategorySubcategory 207 93.00585 23.95935 3.882 0.000104 ***
## subcategorySubcategory 208 3.03433 23.20791 0.131 0.895977
## subcategorySubcategory 209 2.91894 24.35747 0.120 0.904612
## subcategorySubcategory 210 26.05039 28.88953 0.902 0.367208
## subcategorySubcategory 211 1.93459 28.19229 0.069 0.945291

```

```

## subcategorySubcategory 212 -4.16661 32.51021 -0.128 0.898020
## subcategorySubcategory 215 5.20942 23.11439 0.225 0.821688
## subcategorySubcategory 216 3.37663 24.45391 0.138 0.890177
## subcategorySubcategory 217 5.10053 24.88218 0.205 0.837583
## subcategorySubcategory 218 9.31719 23.28668 0.400 0.689079
## subcategorySubcategory 219 10.21690 23.40488 0.437 0.662455
## subcategorySubcategory 220 -1.87934 23.63431 -0.080 0.936621
## subcategorySubcategory 223 2.88227 23.00531 0.125 0.900297
## subcategorySubcategory 224 2.80364 23.05651 0.122 0.903218
## subcategorySubcategory 225 38.01657 25.18823 1.509 0.131228
## subcategorySubcategory 226 2.92054 24.01749 0.122 0.903216
## subcategorySubcategory 228 1.48280 23.07881 0.064 0.948772
## subcategorySubcategory 229 5.73162 23.05328 0.249 0.803652
## subcategorySubcategory 23 4.30684 23.53459 0.183 0.854798
## subcategorySubcategory 230 32.15788 23.49193 1.369 0.171039
## subcategorySubcategory 231 12.61840 23.02865 0.548 0.583733
## subcategorySubcategory 232 8.84879 23.88497 0.370 0.711030
## subcategorySubcategory 233 3.60048 23.13296 0.156 0.876315
## subcategorySubcategory 235 33.63691 23.83563 1.411 0.158191
## subcategorySubcategory 236 -9.71753 32.52080 -0.299 0.765086
## subcategorySubcategory 240 27.34710 23.45626 1.166 0.243670
## subcategorySubcategory 241 -9.00047 32.52086 -0.277 0.781966
## subcategorySubcategory 242 5.64355 23.11641 0.244 0.807127
## subcategorySubcategory 243 4.26843 23.14039 0.184 0.853655
## subcategorySubcategory 244 -0.66722 23.54399 -0.028 0.977392
## subcategorySubcategory 245 20.87313 23.34882 0.894 0.371342
## subcategorySubcategory 246 6.49313 23.38329 0.278 0.781257
## subcategorySubcategory 247 9.51703 23.11481 0.412 0.680540
## subcategorySubcategory 248 8.46445 23.05441 0.367 0.713508
## subcategorySubcategory 249 21.83097 23.07595 0.946 0.344128
## subcategorySubcategory 25 10.07391 23.10418 0.436 0.662823
## subcategorySubcategory 250 3.98043 23.15286 0.172 0.863501
## subcategorySubcategory 251 7.89542 23.02261 0.343 0.731643
## subcategorySubcategory 252 17.65044 23.12488 0.763 0.445308
## subcategorySubcategory 253 -5.09633 23.77133 -0.214 0.830244
## subcategorySubcategory 254 3.14315 23.28218 0.135 0.892611
## subcategorySubcategory 255 7.85529 23.04132 0.341 0.733164
## subcategorySubcategory 256 -0.47672 23.54410 -0.020 0.983846
## subcategorySubcategory 257 22.66755 23.18243 0.978 0.328183
## subcategorySubcategory 258 1.35173 23.13569 0.058 0.953409
## subcategorySubcategory 259 2.87187 23.05484 0.125 0.900867
## subcategorySubcategory 260 17.97596 23.18829 0.775 0.438215
## subcategorySubcategory 261 11.84602 23.18836 0.511 0.609451
## subcategorySubcategory 262 -0.03850 23.77096 -0.002 0.998708
## subcategorySubcategory 264 79.21898 32.52086 2.436 0.014856 *
## subcategorySubcategory 269 6.96867 32.51939 0.214 0.830319
## subcategorySubcategory 270 9.15693 23.11727 0.396 0.692027
## subcategorySubcategory 271 5.05375 23.08872 0.219 0.826741
## subcategorySubcategory 273 13.71334 23.70603 0.578 0.562946
## subcategorySubcategory 274 2.07527 25.18734 0.082 0.934334
## subcategorySubcategory 275 7.52884 23.00975 0.327 0.743516
## subcategorySubcategory 276 -7.76957 37.62931 -0.206 0.836420
## subcategorySubcategory 277 8.47498 24.12098 0.351 0.725325
## subcategorySubcategory 279 5.89523 26.54752 0.222 0.824265

```

```

## subcategorySubcategory 28      6.37618   23.20737   0.275  0.783511
## subcategorySubcategory 281     0.01622   23.97169   0.001  0.999460
## subcategorySubcategory 282     50.14934   29.87280   1.679  0.093204 .
## subcategorySubcategory 285     0.27150   23.14157   0.012  0.990639
## subcategorySubcategory 287     4.48277   23.93654   0.187  0.851444
## subcategorySubcategory 289     8.72121   23.23344   0.375  0.707384
## subcategorySubcategory 29      2.78155   23.02657   0.121  0.903852
## subcategorySubcategory 291    -0.78453   24.70742   -0.032 0.974669
## subcategorySubcategory 292     17.62016   24.46994   0.720  0.471483
## subcategorySubcategory 294     16.21845   23.26603   0.697  0.485751
## subcategorySubcategory 295     19.04097   24.98846   0.762  0.446069
## subcategorySubcategory 296     2.97723   23.86027   0.125  0.900700
## subcategorySubcategory 298     1.83737   28.15551   0.065  0.947969
## subcategorySubcategory 299    -2.19050   23.81764   -0.092 0.926723
## subcategorySubcategory 3      5.05505   23.02199   0.220  0.826203
## subcategorySubcategory 30     15.08025   23.14256   0.652  0.514646
## subcategorySubcategory 300    7.31071   23.04818   0.317  0.751099
## subcategorySubcategory 301    9.90084   23.17886   0.427  0.669272
## subcategorySubcategory 302     6.82946   23.15926   0.295  0.768078
## subcategorySubcategory 303     5.99254   23.01428   0.260  0.794569
## subcategorySubcategory 305    64.83065   23.12647   2.803  0.005060 **
## subcategorySubcategory 31     8.80836   23.03005   0.382  0.702113
## subcategorySubcategory 32     4.44634   24.47903   0.182  0.855867
## subcategorySubcategory 35     2.90661   28.15527   0.103  0.917777
## subcategorySubcategory 36    -3.96924   23.10355   -0.172 0.863594
## subcategorySubcategory 37     18.33687   24.98872   0.734  0.463070
## subcategorySubcategory 4      1.65631   23.31654   0.071  0.943370
## subcategorySubcategory 40     5.83205   24.99533   0.233  0.815509
## subcategorySubcategory 42     68.49644   23.25291   2.946  0.003224 **
## subcategorySubcategory 43     8.19750   23.06547   0.355  0.722290
## subcategorySubcategory 44     5.86767   23.07666   0.254  0.799289
## subcategorySubcategory 45       NA        NA        NA        NA
## subcategorySubcategory 46     1.12094   28.16550   0.040  0.968254
## subcategorySubcategory 47    52.09402   23.12189   2.253  0.024262 *
## subcategorySubcategory 48     12.83665   24.17014   0.531  0.595355
## subcategorySubcategory 50     5.57303   23.46990   0.237  0.812305
## subcategorySubcategory 51    -4.85907   24.60454   -0.197 0.843447
## subcategorySubcategory 52     1.68384   24.01911   0.070  0.944111
## subcategorySubcategory 53     36.83375   34.34844   1.072  0.283565
## subcategorySubcategory 54     11.83722   23.12737   0.512  0.608774
## subcategorySubcategory 56     13.14434   24.62431   0.534  0.593485
## subcategorySubcategory 57     6.62544   23.32765   0.284  0.776399
## subcategorySubcategory 59     10.48007   23.13340   0.453  0.650531
## subcategorySubcategory 6      18.63735   23.18702   0.804  0.421525
## subcategorySubcategory 60     10.10682   23.13286   0.437  0.662183
## subcategorySubcategory 62     24.93571   26.58708   0.938  0.348306
## subcategorySubcategory 64     14.49508   23.12362   0.627  0.530759
## subcategorySubcategory 65     11.94796   23.23961   0.514  0.607170
## subcategorySubcategory 66     5.70303   24.43204   0.233  0.815433
## subcategorySubcategory 68     38.03922   23.66232   1.608  0.107932
## subcategorySubcategory 69     3.71121   23.10474   0.161  0.872389
## subcategorySubcategory 71       NA        NA        NA        NA
## subcategorySubcategory 72     10.56686   23.12363   0.457  0.647693
## subcategorySubcategory 74     6.08238   23.41972   0.260  0.795087

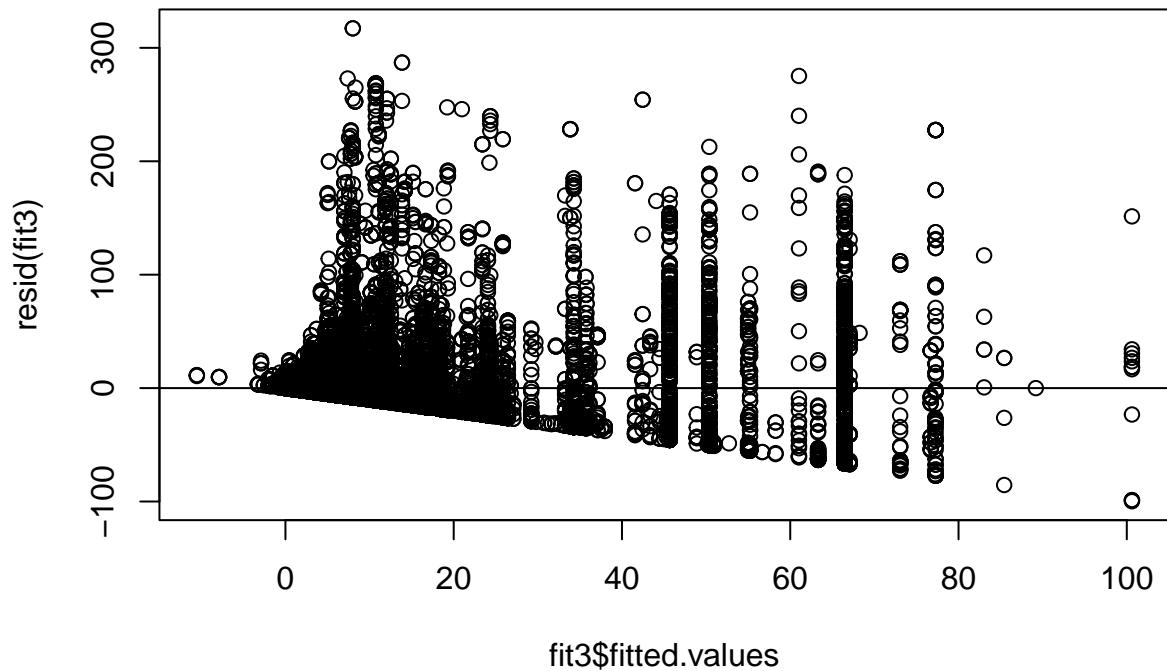
```

```

## subcategorySubcategory 75      5.36602   23.01774   0.233  0.815665
## subcategorySubcategory 77     -5.11881   25.19024  -0.203  0.838975
## subcategorySubcategory 78      9.11517   23.70292   0.385  0.700566
## subcategorySubcategory 8       NA          NA          NA          NA
## subcategorySubcategory 80      9.50605   23.06910   0.412  0.680291
## subcategorySubcategory 82      4.52907   23.11229   0.196  0.844643
## subcategorySubcategory 83      1.84869   24.23859   0.076  0.939204
## subcategorySubcategory 85     15.11069   24.06055   0.628  0.529989
## subcategorySubcategory 86      3.22452   23.21188   0.139  0.889516
## subcategorySubcategory 87      NA          NA          NA          NA
## subcategorySubcategory 88     19.54834   23.03994   0.848  0.396189
## subcategorySubcategory 89      7.20352   23.28378   0.309  0.757034
## subcategorySubcategory 9       9.30865   23.02899   0.404  0.686057
## subcategorySubcategory 90     13.04742   23.36478   0.558  0.576558
## subcategorySubcategory 92      7.93748   23.50976   0.338  0.735647
## subcategorySubcategory 94     11.07521   23.03508   0.481  0.630662
## subcategorySubcategory 95     -9.95116   32.52086  -0.306  0.759611
## subcategorySubcategory 96     36.12910   24.11934   1.498  0.134157
## subcategorySubcategory 97     1.01878   28.15691   0.036  0.971137
## subcategorySubcategory 99     -1.51114   26.65129  -0.057  0.954784
## reassignment_count           0.14946   0.07067   2.115  0.034440 *
## reopen_count                 0.19193   0.58025   0.331  0.740822
## sys_mod_count                -0.07877  0.01813  -4.346  1.39e-05 ***
## made_slatrue                 -7.05654  4.48350  -1.574  0.115519
## impact2 - Medium            -10.14831  9.28253  -1.093  0.274280
## impact3 - Low                -23.04028 10.51063  -2.192  0.028377 *
## urgency2 - Medium            -7.41007  9.18223  -0.807  0.419670
## urgency3 - Low               -15.63251  9.42985  -1.658  0.097370 .
## priority2 - High              9.40603  9.27326   1.014  0.310436
## priority3 - Moderate         21.83157  18.42993  1.185  0.236192
## priority4 - Low               43.50574  19.58396  2.221  0.026321 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 22.97 on 52895 degrees of freedom
## Multiple R-squared:  0.1949, Adjusted R-squared:  0.1906
## F-statistic: 45.08 on 284 and 52895 DF,  p-value: < 2.2e-16

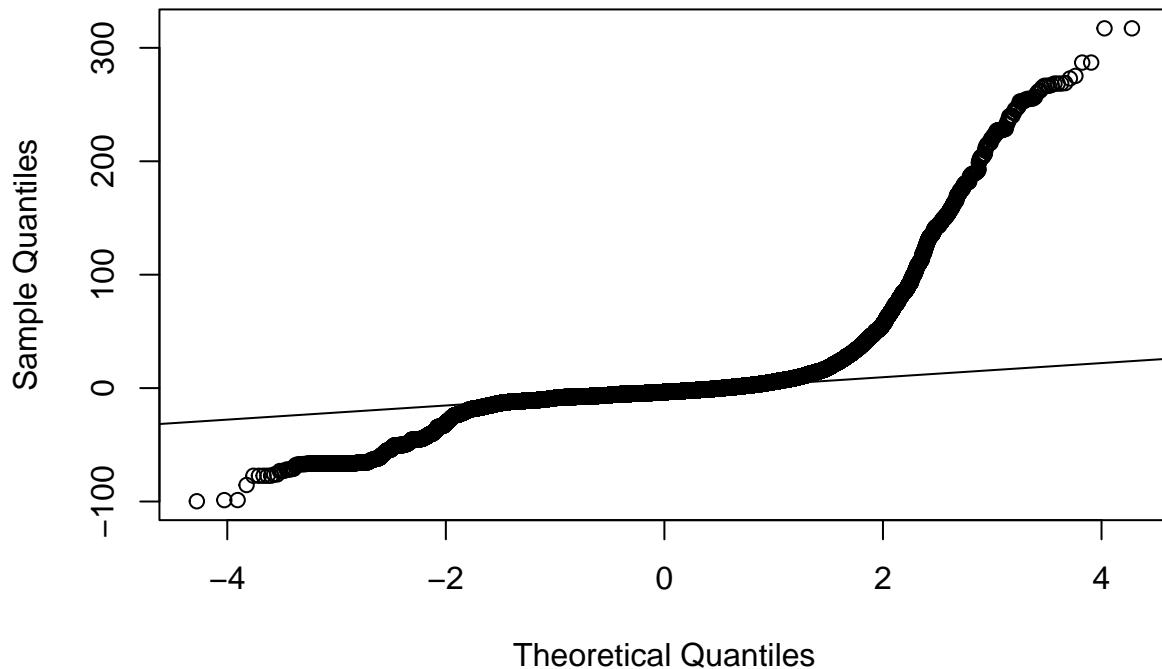
fit3<-lm(time_diff_res_update ~category+subcategory+impact+urgency+priority,data=df_train)
plot(fit3$fitted.values,resid(fit3))
abline(0,0)

```



```
qqnorm(residuals(fit3))
qqline(residuals(fit3))
```

## Normal Q-Q Plot



```
anova(fit3)

## Analysis of Variance Table
##
## Response: time_diff_res_update
##           Df  Sum Sq Mean Sq F value    Pr(>F)
## category      55 4580413  83280 157.765 < 2.2e-16 ***
## subcategory   218 2103611   9650  18.280 < 2.2e-16 ***
## impact         2   19448   9724  18.421 1.006e-08 ***
## urgency        2   18067   9033  17.113 3.720e-08 ***
## priority       3   23344   7781  14.741 1.366e-09 ***
## Residuals    52899 27924154     528
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(fit3)

##
## Call:
## lm(formula = time_diff_res_update ~ category + subcategory +
##     impact + urgency + priority, data = df_train)
##
## Residuals:
##     Min      1Q  Median      3Q     Max 
## -99.75 -7.07 -3.50  1.34 317.19
```

```

##
## Coefficients: (8 not defined because of singularities)
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 8.97444  29.12963   0.308 0.758018
## categoryCategory 12      -11.10449  37.09121  -0.299 0.764649
## categoryCategory 13      -16.52952  18.02863  -0.917 0.359226
## categoryCategory 14      -9.67463  31.99750  -0.302 0.762382
## categoryCategory 15     -21.31042  22.27619  -0.957 0.338750
## categoryCategory 16     -13.27810  33.34396  -0.398 0.690473
## categoryCategory 17     -12.33095  18.02022  -0.684 0.493799
## categoryCategory 19     -13.44136  17.98586  -0.747 0.454868
## categoryCategory 2       -2.52949  29.29220  -0.086 0.931186
## categoryCategory 20     -17.71277  17.89486  -0.990 0.322265
## categoryCategory 21     -11.45074  29.71654  -0.385 0.699993
## categoryCategory 22     -16.49790  19.15832  -0.861 0.389168
## categoryCategory 23     -12.94200  17.87440  -0.724 0.469037
## categoryCategory 24     -8.76465  17.87061  -0.490 0.623817
## categoryCategory 25      15.52776  11.06755   1.403 0.160623
## categoryCategory 26     -16.49510  17.87292  -0.923 0.356058
## categoryCategory 27     -20.65670  24.14520  -0.856 0.392267
## categoryCategory 28     -13.28713  17.88867  -0.743 0.457626
## categoryCategory 29     -33.88191  17.99778  -1.883 0.059765 .
## categoryCategory 3      -51.82605  28.67818  -1.807 0.070743 .
## categoryCategory 30    -15.99292  19.29739  -0.829 0.407244
## categoryCategory 31      10.41320  11.57360   0.900 0.368264
## categoryCategory 32     -17.67716  17.89080  -0.988 0.323129
## categoryCategory 33     -16.91653  17.52511  -0.965 0.334412
## categoryCategory 34      24.94344  17.88736   1.394 0.163181
## categoryCategory 35     -17.24478  18.07190  -0.954 0.339971
## categoryCategory 37     -10.57254  17.88688  -0.591 0.554471
## categoryCategory 38     -8.93207  18.04830  -0.495 0.620674
## categoryCategory 4      -49.57327  23.63259  -2.098 0.035939 *
## categoryCategory 40     -14.63198  17.93871  -0.816 0.414696
## categoryCategory 41     -48.97062  20.06325  -2.441 0.014658 *
## categoryCategory 42     -8.64034  17.86546  -0.484 0.628648
## categoryCategory 43     -16.17511  18.05772  -0.896 0.370393
## categoryCategory 44     -17.67681  17.89430  -0.988 0.323233
## categoryCategory 45     -3.82501  17.86071  -0.214 0.830425
## categoryCategory 46     -9.63685  17.86312  -0.539 0.589556
## categoryCategory 47     -9.24819  18.30729  -0.505 0.613446
## categoryCategory 48     -6.09471  24.00205  -0.254 0.799555
## categoryCategory 49      4.71878  33.34396   0.142 0.887461
## categoryCategory 50     -48.25731  31.21539  -1.546 0.122124
## categoryCategory 51     -19.26670  17.89242  -1.077 0.281571
## categoryCategory 52     -51.86511  20.65261  -2.511 0.012031 *
## categoryCategory 53     -15.54538  17.86707  -0.870 0.384273
## categoryCategory 54     -42.68233  17.81887  -2.395 0.016608 *
## categoryCategory 55     -1.32024  17.94178  -0.074 0.941341
## categoryCategory 56     -33.54821  18.09694  -1.854 0.063772 .
## categoryCategory 57     -14.69865  17.89415  -0.821 0.411410
## categoryCategory 59     -39.89341  21.69147  -1.839 0.065902 .
## categoryCategory 6      -3.73365  37.09121  -0.101 0.919820
## categoryCategory 61     -1.98694  17.97004  -0.111 0.911958
## categoryCategory 62     -7.10039  31.30828  -0.227 0.820588

```

## categoryCategory 63	-16.97991	20.60918	-0.824	0.410000
## categoryCategory 7	-8.06075	18.11570	-0.445	0.656351
## categoryCategory 8	-8.80774	18.88885	-0.466	0.641008
## categoryCategory 9	-13.72638	17.86923	-0.768	0.442397
## categoryNone	9.10579	29.63614	0.307	0.758652
## subcategorySubcategory 10	37.15572	34.35372	1.082	0.279452
## subcategorySubcategory 101	-6.46382	24.22926	-0.267	0.789642
## subcategorySubcategory 102	18.73708	25.76071	0.727	0.467014
## subcategorySubcategory 103	7.56367	23.04614	0.328	0.742764
## subcategorySubcategory 104	-0.47476	10.05865	-0.047	0.962355
## subcategorySubcategory 105	8.71623	23.25381	0.375	0.707788
## subcategorySubcategory 106	3.51765	23.21979	0.151	0.879587
## subcategorySubcategory 107	14.74007	23.18374	0.636	0.524914
## subcategorySubcategory 109	10.38944	23.45976	0.443	0.657867
## subcategorySubcategory 11	4.23187	24.62783	0.172	0.863570
## subcategorySubcategory 110	4.74060	23.08093	0.205	0.837268
## subcategorySubcategory 111	9.32131	25.98322	0.359	0.719788
## subcategorySubcategory 112	-4.00429	23.05476	-0.174	0.862113
## subcategorySubcategory 113	9.13265	23.29257	0.392	0.694998
## subcategorySubcategory 114	5.73614	23.08567	0.248	0.803770
## subcategorySubcategory 115	73.53693	24.13014	3.048	0.002309 **
## subcategorySubcategory 116	6.20270	28.15931	0.220	0.825660
## subcategorySubcategory 117	4.05569	23.04234	0.176	0.860286
## subcategorySubcategory 118	6.57329	23.56028	0.279	0.780247
## subcategorySubcategory 12	-0.06080	26.65461	-0.002	0.998180
## subcategorySubcategory 120	2.93377	23.26734	0.126	0.899661
## subcategorySubcategory 123	5.52338	23.03399	0.240	0.810492
## subcategorySubcategory 125	8.08702	23.04374	0.351	0.725633
## subcategorySubcategory 126	NA	NA	NA	NA
## subcategorySubcategory 127	5.37771	23.19742	0.232	0.816676
## subcategorySubcategory 129	56.12970	27.42682	2.047	0.040710 *
## subcategorySubcategory 13	3.94624	23.11974	0.171	0.864471
## subcategorySubcategory 130	7.35153	23.15271	0.318	0.750848
## subcategorySubcategory 131	NA	NA	NA	NA
## subcategorySubcategory 132	10.63186	23.32200	0.456	0.648483
## subcategorySubcategory 134	12.10613	23.04323	0.525	0.599331
## subcategorySubcategory 135	7.99065	23.02282	0.347	0.728536
## subcategorySubcategory 138	9.20354	28.19605	0.326	0.744114
## subcategorySubcategory 140	2.28812	25.19095	0.091	0.927627
## subcategorySubcategory 141	8.41222	32.54160	0.259	0.796017
## subcategorySubcategory 142	9.13539	23.86660	0.383	0.701893
## subcategorySubcategory 144	-1.86064	23.95396	-0.078	0.938086
## subcategorySubcategory 145	9.16771	23.06293	0.398	0.690994
## subcategorySubcategory 146	8.62994	23.09129	0.374	0.708606
## subcategorySubcategory 149	-11.96637	25.79485	-0.464	0.642718
## subcategorySubcategory 150	14.56375	23.02121	0.633	0.526982
## subcategorySubcategory 151	-34.65018	23.11090	-1.499	0.133802
## subcategorySubcategory 152	10.01586	26.41700	0.379	0.704582
## subcategorySubcategory 153	7.53525	23.06288	0.327	0.743876
## subcategorySubcategory 154	28.19672	23.03199	1.224	0.220866
## subcategorySubcategory 155	15.66204	25.13709	0.623	0.533244
## subcategorySubcategory 156	-2.68566	24.44995	-0.110	0.912534
## subcategorySubcategory 157	0.66287	32.51101	0.020	0.983733
## subcategorySubcategory 158	-21.22428	29.16844	-0.728	0.466834

```

## subcategorySubcategory 159  9.37413  23.15502  0.405 0.685595
## subcategorySubcategory 16  -4.18116  23.35774 -0.179 0.857934
## subcategorySubcategory 160 20.24234  32.95202  0.614 0.539021
## subcategorySubcategory 161 -8.22089  23.95853 -0.343 0.731502
## subcategorySubcategory 162 -31.21065 23.47027 -1.330 0.183592
## subcategorySubcategory 163 17.43046  23.13425  0.753 0.451184
## subcategorySubcategory 164  7.96521  23.00314  0.346 0.729144
## subcategorySubcategory 165      NA       NA       NA       NA
## subcategorySubcategory 166  1.01738  23.91031  0.043 0.966060
## subcategorySubcategory 167  1.67751  23.91298  0.070 0.944074
## subcategorySubcategory 168  9.96875  23.04496  0.433 0.665323
## subcategorySubcategory 169 12.89772  23.93738  0.539 0.590020
## subcategorySubcategory 17  4.10547  24.06383  0.171 0.864533
## subcategorySubcategory 170  6.38478  23.05870  0.277 0.781864
## subcategorySubcategory 171 54.07058  23.81302  2.271 0.023173 *
## subcategorySubcategory 172 13.20643  23.37957  0.565 0.572164
## subcategorySubcategory 174  7.39145  22.99638  0.321 0.747895
## subcategorySubcategory 175  8.47535  23.00792  0.368 0.712601
## subcategorySubcategory 176 -12.81020 30.29570 -0.423 0.672415
## subcategorySubcategory 177 39.38059  23.52276  1.674 0.094107 .
## subcategorySubcategory 178  7.38477  23.17341  0.319 0.749975
## subcategorySubcategory 179  2.30965  32.50977  0.071 0.943362
## subcategorySubcategory 18  5.16758  24.58495  0.210 0.833518
## subcategorySubcategory 181 -2.54230  23.19736 -0.110 0.912731
## subcategorySubcategory 182 13.16680  23.17487  0.568 0.569936
## subcategorySubcategory 183  0.44877  23.08249  0.019 0.984488
## subcategorySubcategory 184  4.34178  23.11808  0.188 0.851027
## subcategorySubcategory 185  3.37276  23.07383  0.146 0.883786
## subcategorySubcategory 186 28.94841  26.26648  1.102 0.270421
## subcategorySubcategory 189  1.31282  23.13739  0.057 0.954752
## subcategorySubcategory 191 14.84249  23.08460  0.643 0.520252
## subcategorySubcategory 192      NA       NA       NA       NA
## subcategorySubcategory 193 20.25762  25.41531  0.797 0.425418
## subcategorySubcategory 194  4.38858  23.62911  0.186 0.852659
## subcategorySubcategory 197 -22.94772 23.39518 -0.981 0.326660
## subcategorySubcategory 198  5.13949  23.21769  0.221 0.824812
## subcategorySubcategory 199  5.74193  24.04220  0.239 0.811241
## subcategorySubcategory 2  6.45331  26.62313  0.242 0.808475
## subcategorySubcategory 20 10.64860  23.13336  0.460 0.645293
## subcategorySubcategory 200 1.85333  23.05194  0.080 0.935921
## subcategorySubcategory 202  9.61655  23.03562  0.417 0.676341
## subcategorySubcategory 203 10.28197  25.92734  0.397 0.691687
## subcategorySubcategory 204  0.65245  32.51101  0.020 0.983989
## subcategorySubcategory 205 -37.69862 24.13558 -1.562 0.118305
## subcategorySubcategory 207 91.10895  23.95889  3.803 0.000143 ***
## subcategorySubcategory 208  3.53713  23.21125  0.152 0.878881
## subcategorySubcategory 209  3.33560  24.36107  0.137 0.891092
## subcategorySubcategory 210 26.65934  28.89385  0.923 0.356186
## subcategorySubcategory 211  2.46257  28.19605  0.087 0.930404
## subcategorySubcategory 212 -3.62250  32.51487 -0.111 0.911291
## subcategorySubcategory 215  5.62436  23.11760  0.243 0.807779
## subcategorySubcategory 216  3.71255  24.45732  0.152 0.879347
## subcategorySubcategory 217  5.51059  24.88561  0.221 0.824753
## subcategorySubcategory 218  9.47444  23.28763  0.407 0.684124

```

```

## subcategorySubcategory 219 10.60032 23.40813 0.453 0.650660
## subcategorySubcategory 220 -1.45329 23.63766 -0.061 0.950975
## subcategorySubcategory 223 3.31658 23.00862 0.144 0.885386
## subcategorySubcategory 224 3.10760 23.05996 0.135 0.892801
## subcategorySubcategory 225 38.20583 25.19164 1.517 0.129372
## subcategorySubcategory 226 3.49014 24.02077 0.145 0.884477
## subcategorySubcategory 228 1.90115 23.08172 0.082 0.934356
## subcategorySubcategory 229 5.94466 23.05671 0.258 0.796541
## subcategorySubcategory 23 4.84827 23.53789 0.206 0.836809
## subcategorySubcategory 230 32.04958 23.49539 1.364 0.172548
## subcategorySubcategory 231 12.96657 23.03192 0.563 0.573449
## subcategorySubcategory 232 9.27045 23.88844 0.388 0.697964
## subcategorySubcategory 233 3.99327 23.13628 0.173 0.862968
## subcategorySubcategory 235 33.84650 23.83915 1.420 0.155676
## subcategorySubcategory 236 -9.33017 32.52561 -0.287 0.774224
## subcategorySubcategory 240 27.60225 23.45968 1.177 0.239367
## subcategorySubcategory 241 -8.53434 32.52561 -0.262 0.793023
## subcategorySubcategory 242 5.97665 23.11959 0.259 0.796014
## subcategorySubcategory 243 4.68952 23.14357 0.203 0.839427
## subcategorySubcategory 244 -0.29353 23.54734 -0.012 0.990054
## subcategorySubcategory 245 20.70139 23.35255 0.886 0.375367
## subcategorySubcategory 246 6.84049 23.38687 0.292 0.769911
## subcategorySubcategory 247 9.94818 23.11798 0.430 0.666963
## subcategorySubcategory 248 8.36903 23.05782 0.363 0.716638
## subcategorySubcategory 249 22.14349 23.07930 0.959 0.337335
## subcategorySubcategory 25 10.41145 23.10780 0.451 0.652309
## subcategorySubcategory 250 4.42258 23.15624 0.191 0.848535
## subcategorySubcategory 251 8.18265 23.02559 0.355 0.722312
## subcategorySubcategory 252 18.04283 23.12805 0.780 0.435319
## subcategorySubcategory 253 -4.75706 23.77461 -0.200 0.841411
## subcategorySubcategory 254 3.65231 23.28547 0.157 0.875364
## subcategorySubcategory 255 8.18809 23.04487 0.355 0.722358
## subcategorySubcategory 256 -0.06361 23.54734 -0.003 0.997845
## subcategorySubcategory 257 22.74425 23.18595 0.981 0.326622
## subcategorySubcategory 258 1.69012 23.13910 0.073 0.941773
## subcategorySubcategory 259 3.20236 23.05843 0.139 0.889545
## subcategorySubcategory 260 18.01554 23.19184 0.777 0.437277
## subcategorySubcategory 261 12.14213 23.19172 0.524 0.600591
## subcategorySubcategory 262 0.19793 23.77457 0.008 0.993357
## subcategorySubcategory 264 79.68511 32.52561 2.450 0.014292 *
## subcategorySubcategory 269 7.54806 32.52387 0.232 0.816479
## subcategorySubcategory 270 9.68703 23.12041 0.419 0.675231
## subcategorySubcategory 271 5.52240 23.09185 0.239 0.810991
## subcategorySubcategory 273 14.33832 23.70929 0.605 0.545344
## subcategorySubcategory 274 2.75367 25.19095 0.109 0.912955
## subcategorySubcategory 275 7.94704 23.01314 0.345 0.729851
## subcategorySubcategory 276 -7.64268 37.63482 -0.203 0.839077
## subcategorySubcategory 277 8.93064 24.12170 0.370 0.711211
## subcategorySubcategory 279 6.50779 26.55122 0.245 0.806377
## subcategorySubcategory 28 6.79105 23.21058 0.293 0.769841
## subcategorySubcategory 281 0.26340 23.97510 0.011 0.991234
## subcategorySubcategory 282 50.42325 29.87758 1.688 0.091482 .
## subcategorySubcategory 285 0.77446 23.14452 0.033 0.973306
## subcategorySubcategory 287 4.96340 23.93992 0.207 0.835755

```

```

## subcategorySubcategory 289  9.19951  23.23665  0.396 0.692177
## subcategorySubcategory 29   3.10192  23.03002  0.135 0.892857
## subcategorySubcategory 291 -0.23864  24.71055 -0.010 0.992295
## subcategorySubcategory 292 17.87055  24.47074  0.730 0.465221
## subcategorySubcategory 294 16.71738  23.26949  0.718 0.472499
## subcategorySubcategory 295 20.24360  24.99083  0.810 0.417920
## subcategorySubcategory 296  3.56997  23.86359  0.150 0.881081
## subcategorySubcategory 298  2.33985  28.15931  0.083 0.933778
## subcategorySubcategory 299 -1.69338  23.82095 -0.071 0.943328
## subcategorySubcategory 3   5.41513  23.02529  0.235 0.814069
## subcategorySubcategory 30  14.65745  23.14601  0.633 0.526566
## subcategorySubcategory 300 7.69750  23.05144  0.334 0.738436
## subcategorySubcategory 301 10.32975  23.18233  0.446 0.655897
## subcategorySubcategory 302  7.17395  23.16274  0.310 0.756776
## subcategorySubcategory 303  6.43678  23.01755  0.280 0.779750
## subcategorySubcategory 305 64.68001  23.12973  2.796 0.005169 **
## subcategorySubcategory 31  9.16653  23.03351  0.398 0.690658
## subcategorySubcategory 32  4.77191  24.48244  0.195 0.845463
## subcategorySubcategory 35  3.47978  28.15931  0.124 0.901652
## subcategorySubcategory 36 -3.53045  23.10702 -0.153 0.878567
## subcategorySubcategory 37 19.58079  24.99083  0.784 0.433326
## subcategorySubcategory 4   2.15116  23.31980  0.092 0.926503
## subcategorySubcategory 40  6.44644  24.99622  0.258 0.796488
## subcategorySubcategory 42 68.49925  23.25660  2.945 0.003227 **
## subcategorySubcategory 43  8.69685  23.06859  0.377 0.706175
## subcategorySubcategory 44  6.31708  23.08002  0.274 0.784314
## subcategorySubcategory 45      NA      NA      NA      NA
## subcategorySubcategory 46  1.66800  28.16937  0.059 0.952783
## subcategorySubcategory 47 51.52977  23.12497  2.228 0.025864 *
## subcategorySubcategory 48 13.42546  24.17360  0.555 0.578639
## subcategorySubcategory 50  6.04414  23.47346  0.257 0.796803
## subcategorySubcategory 51 -4.55578  24.60821 -0.185 0.853126
## subcategorySubcategory 52  2.26527  24.02244  0.094 0.924873
## subcategorySubcategory 53 37.15989  34.35372  1.082 0.279398
## subcategorySubcategory 54 12.04659  23.13059  0.521 0.602503
## subcategorySubcategory 56 13.36607  24.62766  0.543 0.587321
## subcategorySubcategory 57  6.83240  23.33080  0.293 0.769639
## subcategorySubcategory 59 10.76132  23.13656  0.465 0.641846
## subcategorySubcategory 6   18.99690  23.19064  0.819 0.412698
## subcategorySubcategory 60 10.39925  23.13591  0.449 0.653084
## subcategorySubcategory 62 25.35057  26.59078  0.953 0.340412
## subcategorySubcategory 64 14.81029  23.12692  0.640 0.521921
## subcategorySubcategory 65 12.11276  23.24247  0.521 0.602266
## subcategorySubcategory 66  6.10661  24.43553  0.250 0.802660
## subcategorySubcategory 68 38.35025  23.66559  1.621 0.105129
## subcategorySubcategory 69  4.16080  23.10810  0.180 0.857108
## subcategorySubcategory 71      NA      NA      NA      NA
## subcategorySubcategory 72 11.04876  23.12690  0.478 0.632834
## subcategorySubcategory 74  6.69064  23.42306  0.286 0.775152
## subcategorySubcategory 75  5.67671  23.02120  0.247 0.805229
## subcategorySubcategory 77 -4.45636  25.19353 -0.177 0.859599
## subcategorySubcategory 78  9.55656  23.70656  0.403 0.686862
## subcategorySubcategory 8   NA      NA      NA      NA
## subcategorySubcategory 80  9.94828  23.07223  0.431 0.666339

```

```

## subcategorySubcategory 82    4.96757   23.11581   0.215 0.829847
## subcategorySubcategory 83    2.23302   24.24173   0.092 0.926607
## subcategorySubcategory 85    15.55117   24.06383   0.646 0.518122
## subcategorySubcategory 86    3.72132   23.21421   0.160 0.872643
## subcategorySubcategory 87        NA        NA        NA        NA
## subcategorySubcategory 88    19.71553   23.04328   0.856 0.392230
## subcategorySubcategory 89    7.58927   23.28691   0.326 0.744499
## subcategorySubcategory 9     9.60468   23.03233   0.417 0.676674
## subcategorySubcategory 90    13.52304   23.36782   0.579 0.562792
## subcategorySubcategory 92    8.11269   23.51320   0.345 0.730075
## subcategorySubcategory 94    11.46799   23.03841   0.498 0.618643
## subcategorySubcategory 95    -9.48503   32.52561  -0.292 0.770580
## subcategorySubcategory 96    36.82736   24.12229   1.527 0.126843
## subcategorySubcategory 97    1.57606   28.16074   0.056 0.955369
## subcategorySubcategory 99    -0.89182   26.65461  -0.033 0.973309
## impact2 - Medium          -9.96637   9.28395  -1.074 0.283049
## impact3 - Low              -22.61051  10.51193  -2.151 0.031486 *
## urgency2 - Medium         -7.19270   9.18359  -0.783 0.433506
## urgency3 - Low             -15.34103  9.43116  -1.627 0.103821
## priority2 - High           9.26912   9.27471   0.999 0.317607
## priority3 - Moderate       21.51482   18.43281   1.167 0.243134
## priority4 - Low            42.89719   19.58666   2.190 0.028520 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 22.98 on 52899 degrees of freedom
## Multiple R-squared:  0.1946, Adjusted R-squared:  0.1903
## F-statistic: 45.63 on 280 and 52899 DF, p-value: < 2.2e-16

```

## Data prediction regression model

```

pred<-predict(fit,df_test)

## Warning in predict.lm(fit, df_test): prediction from a rank-deficient fit may be
## misleading

mean((df_test$time_diff_res_update-pred)^2)

## [1] 612.0319

pred2<-predict(fit2,df_test)

## Warning in predict.lm(fit2, df_test): prediction from a rank-deficient fit may
## be misleading

mean((df_test$time_diff_res_update-pred2)^2)

## [1] 611.4269

```

```

pred3<-predict(fit3,df_test)

## Warning in predict.lm(fit3, df_test): prediction from a rank-deficient fit may
## be misleading

mean((df_test$time_diff_res_update-pred3)^2)

## [1] 612.3891

```

## Train RandomForest

```

rf <- randomForest(
  as.factor(interval) ~ category+subcategory+incident_state+reassignment_count+reopen_count+sys_mod_count,
  data=df_train
)

rf2<- randomForest(
  as.factor(interval) ~ category+subcategory+reassignment_count+reopen_count+sys_mod_count+made_sla+impacted,
  data=df_train
)

rf3<- randomForest(
  as.factor(interval) ~ category+subcategory+impact+urgency+priority,
  data=df_train
)

```

## Prediction from Random Forest

```

rf_pred<-predict(rf,df_test)
confusionMatrix(rf_pred, as.factor(df_test$interval))

## Confusion Matrix and Statistics
##
##                                     Reference
## Prediction      More than 6 Months Within 2 Weeks Within 6 Months
## More than 6 Months          0          0          0
## Within 2 Weeks           0          6          2
## Within 6 Months          2         37         57
## Within a Day            27        424        165
## Within a Month          0          1          6
## Within a Week           12        384        138
##                                     Reference
## Prediction      Within a Day Within a Month Within a Week
## More than 6 Months          0          0          0
## Within 2 Weeks           4          0          7
## Within 6 Months          110         21         72

```

```

## Within a Day           1268        240        1057
## Within a Month         3           5           5
## Within a Week          753        191        908
##
## Overall Statistics
##
##                         Accuracy : 0.38
##                         95% CI : (0.3676, 0.3925)
## No Information Rate : 0.3621
## P-Value [Acc > NIR] : 0.002199
##
##                         Kappa : 0.0619
##
## McNemar's Test P-Value : NA
##
## Statistics by Class:
##
##                         Class: More than 6 Months Class: Within 2 Weeks
## Sensitivity                  0.000000          0.007042
## Specificity                  1.000000          0.997427
## Pos Pred Value                NaN            0.315789
## Neg Pred Value                0.993057          0.856269
## Prevalence                     0.006943          0.144285
## Detection Rate                 0.000000          0.001016
## Detection Prevalence          0.000000          0.003218
## Balanced Accuracy              0.500000          0.502235
##
##                         Class: Within 6 Months Class: Within a Day
## Sensitivity                  0.154891          0.5931
## Specificity                  0.956294          0.4922
## Pos Pred Value                0.190635          0.3986
## Neg Pred Value                0.944524          0.6806
## Prevalence                     0.062320          0.3621
## Detection Rate                 0.009653          0.2147
## Detection Prevalence          0.050635          0.5387
## Balanced Accuracy              0.555593          0.5426
##
##                         Class: Within a Month Class: Within a Week
## Sensitivity                  0.0109409         0.4431
## Specificity                  0.9972467         0.6167
## Pos Pred Value                0.2500000         0.3806
## Neg Pred Value                0.9231946         0.6758
## Prevalence                     0.0773920         0.3470
## Detection Rate                 0.0008467         0.1538
## Detection Prevalence          0.0033870         0.4041
## Balanced Accuracy              0.5040938         0.5299

rf_pred2<-predict(rf2,df_test)
confusionMatrix(rf_pred2, as.factor(df_test$interval))

##
## Confusion Matrix and Statistics
##                         Reference
## Prediction             More than 6 Months Within 2 Weeks Within 6 Months
## More than 6 Months                  0           0           0
## Within 2 Weeks                  0           4           1

```

```

## Within 6 Months           2          40         32
## Within a Day              31         452        209
## Within a Month             0          5          5
## Within a Week              8         351        121
##
##                               Reference
## Prediction      Within a Day Within a Month Within a Week
## More than 6 Months       0          0          0
## Within 2 Weeks           4          0          3
## Within 6 Months          111        29         83
## Within a Day              1216       241        1096
## Within a Month             3          3          2
## Within a Week              804       184        865
##
## Overall Statistics
##
##                         Accuracy : 0.359
##                         95% CI : (0.3468, 0.3714)
## No Information Rate : 0.3621
## P-Value [Acc > NIR] : 0.6915
##
##                         Kappa : 0.0292
##
## Mcnemar's Test P-Value : NA
##
## Statistics by Class:
##
##                               Class: More than 6 Months Class: Within 2 Weeks
## Sensitivity                  0.000000          0.0046948
## Specificity                  1.000000          0.9984168
## Pos Pred Value                NaN            0.3333333
## Neg Pred Value                0.993057          0.8561005
## Prevalence                    0.006943          0.1442845
## Detection Rate                0.000000          0.0006774
## Detection Prevalence          0.000000          0.0020322
## Balanced Accuracy             0.500000          0.5015558
##
##                               Class: Within 6 Months Class: Within a Day
## Sensitivity                  0.086957          0.5688
## Specificity                  0.952140          0.4614
## Pos Pred Value                0.107744          0.3747
## Neg Pred Value                0.940086          0.6534
## Prevalence                    0.062320          0.3621
## Detection Rate                0.005419          0.2059
## Detection Prevalence          0.050296          0.5495
## Balanced Accuracy             0.519548          0.5151
##
##                               Class: Within a Month Class: Within a Week
## Sensitivity                  0.006565          0.4222
## Specificity                  0.997247          0.6193
## Pos Pred Value                0.166667          0.3708
## Neg Pred Value                0.922881          0.6685
## Prevalence                    0.077392          0.3470
## Detection Rate                0.000508          0.1465
## Detection Prevalence          0.003048          0.3951
## Balanced Accuracy             0.501906          0.5207

```

```

rf_pred3<-predict(rf3,df_test)
confusionMatrix(rf_pred3, as.factor(df_test$interval))

## Confusion Matrix and Statistics
##
##             Reference
## Prediction      More than 6 Months Within 2 Weeks Within 6 Months
## More than 6 Months          0          0          0
## Within 2 Weeks            0          1          1
## Within 6 Months           2         66         39
## Within a Day              22        551        220
## Within a Month            0          0          0
## Within a Week             17        234        108
##             Reference
## Prediction      Within a Day Within a Month Within a Week
## More than 6 Months          0          0          0
## Within 2 Weeks            1          0          0
## Within 6 Months           278         46        238
## Within a Day              1224        275        1236
## Within a Month            0          0          1
## Within a Week             635        136        574
##
## Overall Statistics
##
##                 Accuracy : 0.3113
##                 95% CI : (0.2995, 0.3232)
##                 No Information Rate : 0.3621
##                 P-Value [Acc > NIR] : 1
##
##                 Kappa : -0.0182
##
## McNemar's Test P-Value : NA
##
## Statistics by Class:
##
##             Class: More than 6 Months Class: Within 2 Weeks
## Sensitivity                  0.000000          0.0011737
## Specificity                  1.000000          0.9996042
## Pos Pred Value                NaN          0.3333333
## Neg Pred Value                0.993057          0.8558116
## Prevalence                   0.006943          0.1442845
## Detection Rate                0.000000          0.0001693
## Detection Prevalence          0.000000          0.0005080
## Balanced Accuracy             0.500000          0.5003890
##             Class: Within 6 Months Class: Within a Day
## Sensitivity                  0.105978          0.5725
## Specificity                  0.886220          0.3884
## Pos Pred Value                0.058296          0.3469
## Neg Pred Value                0.937166          0.6155
## Prevalence                   0.062320          0.3621
## Detection Rate                0.006605          0.2073
## Detection Prevalence          0.113294          0.5975
## Balanced Accuracy             0.496099          0.4804

```

```
##                                     Class: Within a Month Class: Within a Week
## Sensitivity                           0.0000000                           0.28014
## Specificity                            0.9998164                           0.70695
## Pos Pred Value                         0.0000000                           0.33685
## Neg Pred Value                         0.9225949                           0.64889
## Prevalence                             0.0773920                           0.34699
## Detection Rate                          0.0000000                           0.09721
## Detection Prevalence                   0.0001693                           0.28857
## Balanced Accuracy                      0.4999082                           0.49354
```