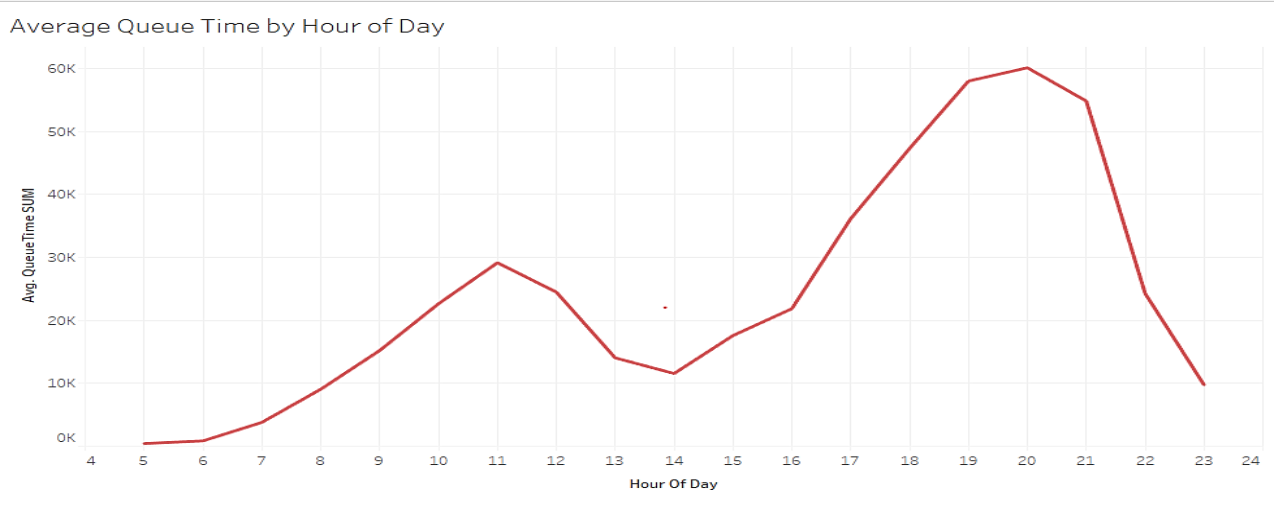
COMCAST CALL CENTER SCHEDULING OPTIMIZATION

Exploratory Data Analysis

(Oct 2017 – Oct 2018)	Total calls	Calls Handled	Calls Abandoned
Totals	32,248,052	31,549,149	698,603
Percentages		97.83	2.17

Call Queue	**Count of Calls**	**%**
Billing	8335252	25.85
Loyalty	4495359	13.94
Repair	**14978471**	**46.45**
Sales	4438670	13.76
Grand Total	32247752	100.00

Call queue times peaked during evenings 7-9pm. This hints that these peak hours may need help with additional resources.



Comcast employs call center staff both off-shore and on-shore. For billing queries, most calls were handled by offshore team and for the rest of the call types, on-shore handled most calls. This gives us insight as to how we could optimize the staffing model.

	OFF-SHORE				**ON-SHORE**			
	Billing	**Loyalty**	**Repair**	**Sales**	**Billing**	**Loyalty**	**Repair**	**Sales**
Total Calls	6,277,514	840,074	7,108,648	584106	1,895,262	3,585,357	**7,403,855**	3674356
%	20	3	23	2	6	11	**24**	12

Customers who called for help with "Repair" waited the longest followed by those who called for help with "Billing".

OPTIMIZATION MODELS

Wait Time Minimization Model (CCWTMM)

CCWTMM Formulation
Parameters:
CM_l = Prescribed call mix ratio by location
CH_h = Expected calls by hour of day
CC_l = Cost per call per location
AWT_{lh} = Historical average wait time by location and hour of day

Decision Variables
CR_{lh} = Calls to be routed to each location for each hour of the day

Objective Function
Minimize lh (AWT * CH)

Model

```
# Call Center Wait Time Minimization Model (CCWTMM)

# Operating framework
set LOC;
set HOD;
# Parameters used for solution
param CALL_MIX{LOC} >= 0;
param CALLS_BY_HOD{HOD} >= 0;
param CALL_COST{LOC} >= 0;
param AWT_BY_LOC_AND_HOD{i in HOD, j in LOC} >= 0;
# Parameters used for analysis
param USA_VOL:= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['USA'];
param PHL_VOL:= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['PHL'];
param MEX_VOL:= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['MEX'];
param JAM_VOL:= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['JAM'];
param USA_COST:= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['USA'] * CALL_COST['USA'];
param PHL_COST:= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['PHL'] * CALL_COST['PHL'];
param MEX_COST:= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['MEX'] * CALL_COST['MEX'];
param JAM_COST:= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['JAM'] * CALL_COST['JAM'];
# Decision variable determines location of calls for each hour
var CALLS_ROUTED{i in HOD, j in LOC} >=0;
# Objective is to minimize total wait time experienced by customers
minimize AWT: sum{i in HOD, j in LOC} AWT_BY_LOC_AND_HOD[i,j]*CALLS_ROUTED[i,j];
# Constraints include meeting expected call volume, and sticking to call mix by location
subject to CALLS_HANDLED {i in HOD}:
    sum {j in LOC} CALLS_ROUTED[i,j] = CALLS_BY_HOD[i];

subject to MIX_LIMIT_USA:
    sum{i in HOD} CALLS_ROUTED[i,'USA'] >= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['USA'];

subject to MIX_LIMIT_PHL:
    sum{i in HOD} CALLS_ROUTED[i,'PHL'] <= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['PHL'];

subject to MIX_LIMIT_MEX:
    sum{i in HOD} CALLS_ROUTED[i,'MEX'] <= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['MEX'];

subject to MIX_LIMIT_JAM:
    sum{i in HOD} CALLS_ROUTED[i,'JAM'] <= sum{i in HOD} CALLS_BY_HOD[i] * CALL_MIX['JAM'];
```

Model Output

```
ampl: include CallCenter_Final_Monahan.run;
Gurobi 8.0.0: optimal solution; objective 1526643
6 simplex iterations
AWT = 1526640

CALLS_ROUTED [*,*]
:        JAM       MEX      PHL      USA     :=
10AM      0          0         0     3739
10PM      0          0       257        0
11AM      0          0         0     4623
11PM      0        120         0        0
12PM      0          0         0     4628
1PM       0          0         0     4829
2PM       0          0         0     4996
3PM       0          0         0     4822
4PM       0          0      4602        0
5AM       0          0         0      120
5PM       0          0      4327        0
6AM       0          0         0      256
6PM       0     3069.2     750.8        0
7AM       0          0         0      759
7PM       0       3344         0        0
8AM       0          0         0     1655
8PM    1045.55   1571.45      0        0
9AM       0          0         0     2861
9PM    1656          0         0        0
;

USA_VOL = 27015.5
USA_COST = 373624
PHL_VOL = 16209.3
PHL_COST = 27069.5
MEX_VOL = 8104.65
MEX_COST = 30392.4
JAM_VOL = 2701.55
JAM_COST = 7753.45
```

Cost Minimization Model (CCMM)

The Call Center Cost Minimization Model (CCMM) focuses on reducing the total staffing costs of a call center while maintaining a predetermined ratio of onshore and offshore employees and satisfying the predetermined call volume by hour. The CCMM is built in AMPL across three distinct files containing text programming of the model itself, the input data, and the execution/result 'run' file.

```
#
#Cost Center Cost Minimization (CCMM) Model
#
set SALARY;
set TIER;
set TIME;
#
param salaries{j in TIER,i in SALARY, t in TIME} >= 0;
param calls{j in TIER, t in TIME} >= 0;
param callLimit{TIER} >= 0;
param employeeMix{SALARY} >=0;
#
var employees{j in TIER, i in SALARY, t in TIME} >=0;
#
minimize cost: sum{j in TIER, i in SALARY, t in TIME} employees[j,i,t]*salaries[j,i,t];
#
subject to incomingCalls {i in SALARY, j in TIER, t in TIME}:
     employees[j,i,t]*callLimit[j] >= calls[j,t];
subject to mixUpper {i in SALARY, t in TIME}:
    sum {j in TIER} employees[j,'onshore',t] >=
    (employeeMix['onshore']/employeeMix['offshore'])*
    (sum {j in TIER} employees[j,'offshore',t]);
```

```
:                  employees salaries    :=
T1 offshore 10AM    78          3
T1 offshore 11AM    70.6        3
T1 offshore 12AM    60          3
T1 offshore 1PM     55          3
T1 offshore 2PM     70          3
T1 offshore 3PM     83.75       3
T1 offshore 4PM     74.5        3
T1 offshore 5PM     65          3
T1 offshore 8AM     75          3
T1 offshore 9AM     80          3
T1 onshore  10AM   243.5        9.99
T1 onshore  11AM   220.533      9.99
T1 onshore  12AM   165          9.99
T1 onshore  1PM    214.667      9.99
T1 onshore  2PM    249.333      9.99
T1 onshore  3PM    261.833      9.99
T1 onshore  4PM    235.833      9.99
T1 onshore  5PM    182.667      9.99
T1 onshore  8AM    240.333      9.99
T1 onshore  9AM    256          9.99
```