

OPTIMIZED RESOURCE ALLOCATION FOR A TWO SIDED MARKET

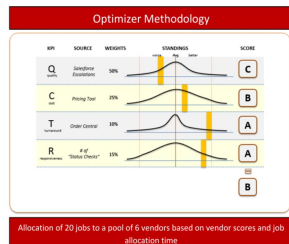
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Introduction

- Client is a multi-national global information services organization specializing in corporate legal services.
- Client currently has a customer-vendor management system that allocates the jobs requested by the customers to the vendors, which involves a lot of paperwork.
- The client wants to automate this customer-vendor management system. A platform was created, which can automate the job allocation process by optimizing quality, turnaround, responsiveness and cost of the job.
- This platform can highly reduce the hassle of paperwork involved, the wait time for customers, and the money spent.

Model Design

- Linear programming model was used to allocate jobs optimally based on the scores.
- A basic static linear programming model was formed in excel and using Gurobi optimizer it was extended for dynamic data.



Assumptions

- Forced Ranking method is used for job allocation - Top 4 Vendors.
- When 4 vendors are not available the jobs are allocated to the available vendors.
- Vendors read from the input file are checked-in and ready for job allocation.
- When the maximum score is less than 85 the model waits for 20 minutes for the input to be read.

Inputs	V1	V2	V3	V4
Quality	50	45	45	40
Cost	25	20	20	20
TAT	15	15	10	10
Responsiveness	10	10	10	10
Score	100	90	85	80

Number of vendors available for allocation	1st ranked vendor	2nd ranked vendor	3rd ranked vendor	4th ranked vendor
4	60	20	15	5
3	70	20	10	
2	80	20		
1	100			

Methodology

- Unique score creation (Vendor score * job * job priority _score) for maximizing the allocation.
- Jobs are prioritized based on the in time : First in First out approach.
- Different scenarios created to stress test the model.

Constraints

- Vendors can have multiple jobs but one job can have only one vendor
- Allocation constraints were implemented based on forced ranking scenarios

m = Number of Vendors
n = Number of Jobs

J1...Jn = Jobs
V1...Vn = Vendors

Allocation constraint for each vendor
 $V1(J1+J2+...+Jn) \leq m*0.6$ if n=4
 $V2(J1+J2+...+Jn) \leq m*0.2$ if n=4
 $V3(J1+J2+...+Jn) \leq m*0.15$ if n=4
 $V4(J1+J2+...+Jn) \leq m*0.05$ if n=4
 $V1(J1+J2+...+Jn) \leq m*0.7$ if n=3
 $V1(J1+J2+...+Jn) \leq m*0.2$ if n=3
 $V1(J1+J2+...+Jn) \leq m*0.1$ if n=3
 $V1(J1+J2+...+Jn) \leq m*0.5$ if n=2
 $V1(J1+J2+...+Jn) \leq m*0.2$ if n=2
 $V1(J1+J2+...+Jn) \leq m*1$ if n=1

Sum of vendors per job should be equal to one.
 $J1(V1+V2+...+Vn) = 1$
 $J2(V1+V2+...+Vn) = 1$
 $J3(V1+V2+...+Vn) = 1$
 $J4(V1+V2+...+Vn) = 1$
 $J5(V1+V2+...+Vn) = 1$
 $J6(V1+V2+...+Vn) = 1$
 $J7(V1+V2+...+Vn) = 1$
 $J8(V1+V2+...+Vn) = 1$
 $J9(V1+V2+...+Vn) = 1$
 $J10(V1+V2+...+Vn) = 1$
 $J11(V1+V2+...+Vn) = 1$
 $J12(V1+V2+...+Vn) = 1$
 $J13(V1+V2+...+Vn) = 1$
 $J14(V1+V2+...+Vn) = 1$
 $J15(V1+V2+...+Vn) = 1$
 $J16(V1+V2+...+Vn) = 1$
 $J17(V1+V2+...+Vn) = 1$
 $J18(V1+V2+...+Vn) = 1$
 $J19(V1+V2+...+Vn) = 1$
 $J20(V1+V2+...+Vn) = 1$

Results

Data

- The model needs two input files:
- Job Id and their arrival time
- Scores for individual vendors and respective vendor ID.

Output

The output is stored in a text file has the following details Vendor ID, allocated number of jobs for the respective vendor and average vendor score

Job_Id	Arrival_Time	Job_Id	Arrival_Time
3106	1148	3106	1210
2024	1411	2024	906
4276	1104	4276	1600
5628	1303	5628	1500
1149	1442	1149	913
3173	1434	3173	1125
2475	1043	2475	1023
3773	1010	3773	930
7996	1125	7996	1200
6541	1148	6541	933
7931	1224	7931	934
5679	1242	5679	940
7564	1205	7564	1320
7431	1214	7431	1450
7098	1340	7098	955
7234	1227	7234	1010
9135	1419	9135	935
6168	1248	6168	1020
8472	1335	8472	1034
6968	1335	6968	1123

Scenario 1

Number of Vendors: 6
Number of Jobs: 20
Allocation by the model

Vendor_ID	Count	Score
738	3.0	0.928571429
189	12.0	0.886363636
1065	1.0	0.905172414
185	4.0	0.942307692
		0.927197802
Average vendor score:	93.783	185 0.93404908

Scenario 2

Number of Vendors: 3
Number of Jobs: 20
Allocation by the model

Vendor_ID	Count	Score
738	2.0	0.78571429
11797	4.0	0.786363636
1000	14.0	0.865172414
Average vendor score:	84.149	

Scenario 3

Number of Vendors: 2
Number of Jobs: 20
Allocation by the model

Vendor_ID	Count	Score
738	16.0	0.95571429
11797	4.0	0.786363636
Average vendor score:	92.184	

Scenario 4

Number of Vendors: 1
Number of Jobs : 20
Allocation by the model

Vendor_ID	Count	Score
738	20.0	0.95571429
Average vendor score:	95.57	

Job_Vendor	Arrival Time	Priority Score	V1	V2	V3	V4	Job Allocated	Maximum Job Allocated
J1	530	770	1	0	0	0	1	1
J2	535	765	1	0	0	0	1	1
J3	540	760	1	0	0	0	1	1
J4	545	755	1	0	0	0	1	1
J5	550	750	1	0	0	0	1	1
J6	555	745	1	0	0	0	1	1
J7	560	740	1	0	0	0	1	1
J8	565	735	1	0	0	0	1	1
J9	570	730	1	0	0	0	1	1
J10	575	725	1	0	0	0	1	1
J11	580	720	1	0	0	0	1	1
J12	585	715	1	0	0	0	1	1
J13	590	710	1	0	0	0	1	1
J14	595	705	1	0	0	0	1	1
J15	600	700	1	0	0	0	1	1
J16	605	695	1	0	0	0	1	1
J17	610	690	1	0	0	0	1	1
J18	615	685	1	0	0	0	1	1
J19	620	680	1	0	0	0	1	1
J20	625	675	1	0	0	0	1	1
J21	630	670	1	0	0	0	1	1
J22	635	665	1	0	0	0	1	1
J23	640	660	1	0	0	0	1	1
J24	645	655	1	0	0	0	1	1
J25	650	650	1	0	0	0	1	1
J26	655	645	1	0	0	0	1	1
J27	660	640	1	0	0	0	1	1
J28	665	635	1	0	0	0	1	1
J29	670	630	1	0	0	0	1	1
J30	675	625	1	0	0	0	1	1
J31	680	620	1	0	0	0	1	1
J32	685	615	1	0	0	0	1	1
J33	690	610	1	0	0	0	1	1
J34	695	605	1	0	0	0	1	1
J35	700	600	1	0	0	0	1	1
J36	705	595	1	0	0	0	1	1
J37	710	590	1	0	0	0	1	1
J38	715	585	1	0	0	0	1	1
J39	720	580	1	0	0	0	1	1
J40	725	575	1	0	0	0	1	1
J41	730	570	1	0	0	0	1	1
J42	735	565	1	0	0	0	1	1
J43	740	560	1	0	0	0	1	1
J44	745	555	1	0	0	0	1	1
J45	750	550	1	0	0	0	1	1
J46	755	545	1	0	0	0	1	1
J47	760	540	1	0	0	0	1	1
J48	765	535	1	0	0	0	1	1
J49	770	530	1	0	0	0	1	1
J50	775	525	1	0	0	0	1	1
J51	780	520	1	0	0	0	1	1
J52	785	515	1	0	0	0	1	1
J53	790	510	1	0	0	0	1	1
J54	795	505	1	0	0	0	1	1
J55	800	500	1	0	0	0	1	1
J56	805	495	1	0	0	0	1	1
J57	810	490	1	0	0	0	1	1
J58	815	485	1	0	0	0	1	1
J59	820	480	1	0	0	0	1	1
J60	825	475	1	0	0	0	1	1
J61	830	470	1	0	0	0	1	1
J62	835	465	1	0	0	0	1	1
J63	840	460	1	0	0	0	1	1
J64	845	455	1	0	0	0	1	1
J65	850	450	1	0	0	0	1	1
J66	855	445	1	0	0	0	1	1
J67	860	440	1	0	0	0	1	1
J68	865	435	1	0	0	0	1	1
J69	870	430	1	0	0	0	1	1
J70	875	425	1	0	0	0	1	1
J71	880	420	1	0	0	0	1	1
J72	885	415	1	0	0	0	1	1
J73	890	410	1	0	0	0	1	1
J74	895	405	1	0	0	0	1	1
J75	900	400	1	0	0	0	1	1
J76	905	395	1	0	0	0	1	1
J77	910	390	1	0	0	0	1	1
J78	915	385	1	0	0	0	1	1
J79	920	380	1	0	0	0	1	1
J80	925	375	1	0	0	0	1	1
J81	930	370	1	0	0	0	1	1
J82	935	365	1	0	0	0	1	1
J83	940	360	1	0	0	0	1	1
J84	945	355	1	0	0	0	1	1
J85	950	350	1	0	0	0	1	1
J86	955	345	1	0	0	0	1	1
J87	960	340	1	0	0	0	1	1
J88	965	335	1	0	0	0	1	1
J89	970	330	1	0	0	0	1	1
J90	975	325	1	0	0	0	1	1
J91	980	320	1	0	0	0	1	1
J92	985	315	1	0	0	0	1	1
J93	990	310	1	0	0	0	1	1
J94	995	305	1	0	0	0	1	1
J95	1000	300	1	0	0	0	1	1
J96	1005	295	1	0	0	0	1	1
J97	1010	290	1	0	0	0	1	1
J98	1015	285	1	0	0	0	1	1
J99	1020	280	1	0	0	0	1	1
J100	1025	275	1	0	0	0	1	1
J101	1030	270	1	0	0	0	1	1
J102	1035	265	1	0	0	0	1	1
J103	1040	260	1	0	0	0	1	1
J104	1045	255	1	0	0	0	1	1
J105	1050	250	1	0	0	0	1	1
J106	1055	245	1	0	0	0	1	1
J107	1060	240	1	0	0	0	1	1
J108	1065	235	1	0	0	0	1	1
J109	1070	230	1	0	0	0	1	1
J110	1075	225	1	0	0	0	1	1
J111	1080	220	1	0	0	0	1	1
J112	1085	215	1	0	0	0	1	1
J113	1090	210	1	0	0	0	1	1
J114	1095	205	1	0	0	0	1	1
J115	1100	200	1	0	0	0	1	1
J116	1105	195	1	0	0	0	1	1
J117	1110	190	1	0	0	0	1	1
J118	1115	185	1	0	0	0	1	1
J119	1120	180	1	0	0	0	1	1
J120	1125	175	1	0	0	0	1	1
J121	1130	170	1	0	0	0	1	1
J122	1135	165	1	0	0	0	1	1
J123	1140	160	1	0	0	0	1	1
J124	1145	155	1	0	0	0	1	1
J125	1150	150	1	0	0	0	1	1
J126	1155	145	1	0	0	0	1	1
J127	1160	140	1	0	0	0	1	1
J128	1165	135	1	0	0	0	1	1
J129	1170	130	1	0	0	0	1	1
J130	1175	125	1	0	0	0	1	1
J131	1180	120	1	0	0	0	1	1
J132	1185	115	1	0	0	0	1	1
J133	1190	110	1	0	0	0	1	1
J134	1195	105	1	0	0	0	1	1
J135	1200	100	1	0	0	0	1	1
J136	1205	95	1	0	0	0	1	1
J137	1210	90	1	0	0	0	1	1
J138	1215	85	1	0	0	0	1	1
J139	1220	80	1	0	0	0	1	1
J140	1225	75	1	0	0	0	1	1
J141	1230	70	1	0	0	0	1	1
J142	1235	65	1	0	0	0	1	1
J143	1240	60	1	0	0	0	1	1
J144	1245	55	1	0	0	0	1	1
J145	1250	50	1	0	0	0	1	1
J146	1255	45	1	0	0	0	1	1
J147	1260	40	1	0	0	0	1	1
J148	1265	35	1	0	0	0	1	1
J149	1270	30	1	0	0	0	1	1
J150	1275	25	1	0	0	0	1	1
J151	1280	20	1	0	0	0	1	1
J152	1285	15	1	0	0	0	1	1
J153	1290	10	1	0	0	0	1	1
J154	1295	5	1	0	0	0	1	1
J155	1300	0	1	0	0	0	1	1
J156	1305	-5	1	0	0	0	1	1
J157	1310	-10	1	0	0	0	1	1
J158	1315	-15	1	0	0	0	1	1
J159	1320	-20	1	0	0	0	1	1
J160	1325	-25	1	0	0	0	1	1
J161	1330	-30	1	0	0	0	1	1
J162	1335	-35	1	0	0	0	1	1
J163	1340	-40	1	0	0	0	1	1
J164	1345	-45	1	0	0	0	1	1
J165	1350	-50	1	0	0	0	1	1
J166	1355	-55	1	0	0	0	1	1
J167	1360	-60	1	0	0	0	1	1
J168	1365	-65	1	0	0	0	1	1
J169	1370	-70	1	0	0	0	1	1
J170	1375	-75	1	0	0	0	1	1
J171	1380	-80	1	0	0	0	1	1
J172	1385	-85	1	0	0	0	1	1
J173	1390	-90	1	0	0	0	1	1
J174	1395	-95	1	0	0	0	1	1
J175	1400	-100	1	0	0	0	1	1
J176	1405	-105	1	0	0	0	1	1
J177	1410	-110	1	0	0	0	1	1
J178	1415	-115	1	0	0	0	1	1
J179	1420	-120	1	0	0	0	1	1
J180	1425	-125	1	0	0	0	1	1
J181	1430	-130	1	0	0	0	1	1
J182	1435	-135	1	0	0	0	1	1
J183	1440	-140	1	0	0	0	1	1
J184	1445	-145	1	0	0	0	1	1
J185	1450	-150	1	0	0	0	1	1
J186	1455	-155	1	0	0	0	1	1
J187	1460	-160	1	0	0	0	1	1
J188	1465	-165	1	0	0	0	1	1
J189	1470	-170	1	0	0	0	1	1
J190	1475	-175	1	0	0	0	1	1
J191	1480	-180	1	0	0	0	1	1
J192	1485	-185	1	0	0	0	1	1
J193	1490	-190	1	0	0	0	1	1
J194	1							