Assignment 1 – Prescriptive Analytics

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Question 1: Project Management

1. The optimized minimum cost for this project is 950 euros. The full duration of all activities are 8 days. Specifically, both activity 1 and 2 will start at day 0. Following that, day 3 is the start day for activities 3, 4 and 5. Consequently, activity 6 begins on day 5 and activity 7 starts on day 6. Lastly, activity 8 starts on day 8 and finalize the process on day 8.
   Moreover, regarding the number of crashing days, to optimize the plan for the minimum operating cost, the project witnesses 1 day of crashing in activity 2 duration. Additionally, the number of crashed days for activity 5 and activity 6 are 1 day and 2 days respectively. Thus, the above crashed days explain for the order in starting day of all activities.

2. The optimization cost and plan do not change when addressing the problem as a continuous linear programming. The indifferent results can stem from the type of data figures. In the given data, the core figures such as duration, crashed days, and more are integer value. The current results would for integer linear programming are calculated. Thus, despite the direction to putting continuous variables in the problem, the solution would be the same for integer linear programming solution as well as the continuous linear programming due to the features of data.

3. In this issue, modifications in the given data can make a difference in determining the difference between linear programming and integer linear programming. If the data table contains continuous figures, then the difference between integer and continuous linear programming in this problem may occur. For instance, activity 2 takes 2.5 days to finish.

4. The sensitivity analysis yields a significant range for adjustments in different aspects of the problem to get comparable findings. The findings indicate that all activities can increase and decrease within the following range to keep the optimization unchanged.

   Start day, activities can be changed within the range from -7.0e+01 to 6.5e+01 days as the starting point.

   Crashed days, the beginning range is from -1.0e+30 to 4.0e+01 days to maintain the same results.

   To retain the findings, the average value in which both choice variables to change at peak in days will be 6.25e+29 days.

   Accordingly, the sensitivity analysis shows that managers would not need to worry about uncertain changes happen to one of the activities, which could not affect the optimization plan.

Question 2:

Table with the shortest duration via any possible subtour between each pair of customers:

"ID"	"1"	"2"	"3"	"4"	"5"	"6"	"7"	"8"	"9"	"10"	"11"	"12"	"13"	"14"	"15"	"16"	"17"	"18"	"19"	"20"	"21"	"22"	"23"	"24"	"25"	"26"	"27"	"28"	"29"	"30"
1	0	37	47	159	40	54	143	142	230	2	243	22	224	66	167	173	70	115	36	74	85	25	26	12	194	10	104	80	170	197
2	98	0	10	122	93	117	145	195	238	30	191	14	168	22	236	196	44	128	104	66	158	44	2	127	120	58	58	137	113	170
3	132	74	0	112	118	143	208	238	217	34	114	64	120	77	263	161	13	153	71	22	144	124	39	115	191	22	15	93	89	155
4	205	176	138	0	188	296	302	336	264	186	38	164	23	204	275	152	184	196	166	101	210	236	205	288	143	171	175	225	120	66
5	17	54	64	176	0	74	130	161	229	75	164	68	213	23	187	168	90	78	16	76	29	62	102	90	212	101	46	76	138	178
6	69	111	115	276	38	0	86	80	154	96	211	113	310	143	189	268	186	109	99	101	16	39	74	60	253	131	178	138	172	193
7	139	143	221	373	147	78	0	2	299	161	295	117	324	93	212	322	194	147	88	194	44	108	205	73	281	144	206	245	224	226
8	112	208	274	350	106	97	84	0	269	179	370	115	377	171	282	280	267	185	133	211	65	149	203	79	318	154	185	195	263	303
9	207	202	231	353	208	218	308	289	0	244	350	208	366	259	9	265	257	103	200	170	141	175	257	194	291	177	199	102	233	213
10	35	40	89	137	46	52	151	135	210	0	211	8	212	37	181	230	72	138	35	21	88	18	49	87	160	5	44	130	155	161
11	249	172	197	31	228	239	348	342	335	199	0	239	54	182	309	133	179	218	246	179	258	177	194	203	108	222	191	197	170	104
12	43	101	36	186	26	47	102	134	204	17	174	0	178	68	231	160	38	123	2	105	70	16	96	81	174	48	115	112	132	94
13	215	163	175	49	208	267	305	307	342	181	14	204	0	218	340	102	107	200	263	197	279	259	207	257	94	220	211	169	194	140
14	62	51	93	170	54	111	139	169	260	59	166	36	207	0	238	209	88	85	89	36	124	44	5	108	188	59	33	163	133	138
15	152	220	174	325	163	216	254	197	25	240	278	230	316	216	0	193	177	91	144	180	168	163	174	188	203	192	200	68	160	241
16	237	180	184	81	212	269	272	347	258	178	164	217	105	186	207	0	172	178	229	204	190	179	160	263	43	193	148	83	99	29
17	59	48	13	117	81	167	156	261	264	101	165	37	117	56	216	162	0	86	47	48	145	74	37	185	127	9	25	108	106	102
18	119	98	109	184	49	91	182	143	76	117	223	62	266	139	97	168	93	0	103	71	45	110	159	90	153	134	104	50	86	131
19	45	45	109	175	45	105	87	128	170	1	252	41	235	65	204	228	71	35	0	59	40	28	55	25	204	23	47	125	154	108
20	59	62	22	185	84	99	214	243	222	48	129	30	106	44	237	208	14	125	31	0	110	104	55	177	162	80	8	108	90	129
21	23	91	172	279	12	16	110	52	126	79	201	64	231	118	120	283	167	67	114	178	0	110	91	51	170	75	154	139	132	182
22	12	9	91	182	82	117	82	128	193	72	196	25	186	64	160	159	117	68	32	32	129	0	1	85	237	19	35	106	158	167
23	16	50	12	120	114	95	145	169	272	24	201	22	147	19	217	195	37	142	44	58	157	97	0	93	194	19	41	131	142	167
24	66	145	149	205	81	15	59	97	203	60	271	60	223	112	188	270	146	42	106	125	52	123	153	0	251	132	106	111	209	198
25	177	198	140	130	173	264	283	318	218	236	98	150	109	183	258	14	116	202	219	180	177	216	216	234	0	197	159	136	55	83
26	31	48	108	132	67	136	98	214	186	5	199	30	182	14	203	233	35	84	43	46	117	5	52	114	237	0	14	179	127	154
27	118	3	8	133	52	148	171	229	214	32	209	90	211	40	183	176	62	81	92	16	175	112	11	111	122	57	0	150	118	89
28	165	163	133	226	63	100	192	225	120	151	219	109	183	142	106	172	83	91	119	77	153	170	192	72	149	146	171	0	93	106
29	117	159	168	158	146	145	211	287	240	203	168	92	130	96	174	48	93	87	150	130	133	153	116	131	75	163	88	103	0	87
30	193	176	139	67	156	242	228	288	207	133	62	178	132	131	267	38	129	210	103	75	190	196	149	153	104	154	87	151	67	0