Solução do Problema Boeing1 - Solver HiGHS

Análise Computacional

17 de setembro de 2025

1 Informações do Problema

Informações do Problema:

- Nome: Boeing1
- Número de Variáveis: 384
- Número de Restrições: 351
- Inviabilidade Primal: 0.000e+00
- Inviabilidade Dual: 2.776e-17
- Valor Primal: -3.352e+02
- Valor Dual: -3.268e+02
- Gap: -2.526e-19
- Número de Iterações: 24

2 Variáveis Primais e Custos Reduzidos

Tabela 1: Variáveis primais e custos reduzidos do problema Boeing1

Coordenada x	Valor x	Coordenada z	Valor z
1	-0.000000	1	0.000000
2	12.000000	2	0.000000
3	0.000000	3	0.055156
4	0.000000	4	0.068792
5	14.000000	5	0.000000
6	0.000000	6	0.013301
7	0.000000	7	0.013311
8	-0.000000	8	0.000000
9	0.000000	9	0.029941
10	49.000000	10	0.000000
11	73.000000	11	0.000000
12	60.000000	12	0.000000
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Coordenada x	Valor x	Coordenada z	Valor z
13	1.000000	13	0.000000
14	0.000000	14	0.008162
15	3.000000	15	0.000000
16	0.000000	16	0.008152
17	47.165493	17	0.000000
18	310.767862	18	0.000000
19	0.325000	19	0.000000
20	317.741645	20	0.000000
21	-0.000000	21	0.000000
22	0.000000	22	0.016295
23	0.000000	23	0.006858
24	26.000000	24	0.000000
25	0.000000	25	0.005219
26	37.000000	26	0.000000
27	0.000000	27	0.000000
28	0.000000	28	0.000000
29	215.000000	29	0.000000
30	0.000000	30	0.000000
31	27.000000	31	0.000000
32	83.000000	32	0.000000
33	0.000000	33	0.002301
34	278.000000	34	0.000000
35	104.048235	35	0.000000
36	33.040000	36	0.000000
37	68.205882	37	0.000000
38	98.000000	38	0.000000
39	0.000000	39	0.058858
40	5.000000	40	0.000000
41	0.000000	41	0.058868
42	1.000000	42	0.000000
43	-0.000000	43	0.000000
44	157.794393	44	0.000000
45	-0.000000	45	0.000000
46	35.000000	46	0.000000
47	0.000000	47	0.000807
48	0.000000	48	0.000817
49	94.205607	49	0.000000
50	-0.000000	50	0.000000
51	39.794393	51	0.000000
52	70.013273	52	0.000000
53	342.986727	53	0.000000
54	0.000000	54	0.000000
55	37.000000	55	0.000000
56	38.558824	56	0.000000
57	6.955882	57	0.000000
58	32.485294	58	0.000000
59	0.000000	59	0.008266
60	-0.000000	60	0.000000
61	0.000000	61	0.008266

Coordenada x	Valor x	Coordenada z	Valor z
62	546.014706	62	0.000000
63	3.720588	63	0.000000
64	139.000000	64	0.000000
65	66.267442	65	0.000000
66	0.000000	66	0.004499
67	75.000000	67	0.000000
68	5.415869	68	0.000000
69	33.040000	69	0.000000
70	260.848837	70	0.000000
71	839.963272	71	0.000000
72	87.906977	72	0.000000
73	168.000000	73	0.000000
74	98.000000	74	0.000000
75	1464.240914	75	0.000000
76	8.581395	76	0.000000
77	0.000000	77	0.009982
78	0.000000	78	0.000000
79	22.418605	79	0.000000
80	41.000000	80	0.000000
81	0.000000	81	0.025647
82	0.000000	82	0.015665
83	0.000000	83	0.015665
84	0.000000	84	0.004747
85	153.755814	85	0.000000
86	39.244186	86	0.000000
87	0.000000	87	0.000000
88	0.000000	88	0.000000
89	2.000000	89	0.000000
90	0.000000	90	0.000000
91	151.000000	91	0.000000
92	0.000000	92	0.128389
93	-0.000000	93	0.000000
94	51.000000	94	0.000000
95	0.000000	95	0.000000
96	13.000000	96	0.000000
97	37.891085	97	0.000000
98	77.153033	98	0.000000
99	6.955882	99	0.000000
100	177.000000	100	0.000000
101	23.104320	101	0.000000
102	24.895680	102	0.000000
103	0.000000	103	0.002793
104	0.000000	104	0.000000
105	68.000000	105	0.000000
106	0.000000	106	0.128399
107	0.000000	107	0.000010
108	24.000000	108	0.000000
109	-0.000000	109	0.000000
110	291.000000	110	0.000000

Coordenada x	Valor x	Coordenada z	Valor z
111	67.000000	111	0.000000
112	-0.000000	112	0.000000
113	839.963272	113	0.000000
114	146.680914	114	0.000000
115	236.600000	115	0.000000
116	0.000000	116	0.186799
117	50.755814	117	0.000000
118	168.000000	118	0.000000
119	0.000000	119	0.000000
120	0.000000	120	0.000000
121	0.000000	121	0.005483
122	83.418605	122	0.000000
123	75.802326	123	0.000000
124	-0.000000	124	0.000000
125	0.000000	125	0.005483
126	79.197674	126	0.000000
127	164.859813	127	0.000000
128	0.000000	128	0.000980
129	0.000000	129	0.003773
130	392.000000	130	0.000000
131	0.000000	131	0.000895
132	70.013273	132	0.000000
133	-0.000000	133	0.000000
134	50.755814	134	0.000000
135	47.165493	135	0.000000
136	0.000000	136	0.000000
137	0.000000	137	0.005483
138	0.000000	138	0.000000
139	6.000000	139	0.000000
140	-0.000000	140	0.000000
141	0.000000	141	0.005483
142	0.000000	142	-0.000000
143	17.000000	143	0.000000
144	260.848837	144	0.000000
145	37.151163	145	0.000000
146	19.395349	146	0.000000
147	0.000000	147	0.000000
148	91.604651	148	0.000000
149	0.000000	149	0.000000
150	57.000000	150	0.000000
151	91.000000	151	0.000000
152	36.408451	152	0.000000
153	134.134392	153	0.000000
154	139.690491	154	0.000000
155	4.766667	155	0.000000
156	0.000000	156	0.005219
157	234.317292	157	0.000000
158	0.000000	158	0.005272
159	178.682708	159	0.000000

Coordenada x	Valor x	Coordenada z	Valor z
160	19.031690	160	0.000000
161	266.681846	161	0.000000
162	-0.000000	162	0.000000
163	412.874082	163	0.000000
164	1913.412382	164	0.000000
165	14.679577	165	0.000000
166	271.317292	166	0.000000
167	138.003130	167	0.000000
168	4.352113	168	0.000000
169	241.283575	169	0.000000
170	126.364312	170	0.000000
171	14.679577	171	0.000000
172	138.003130	172	0.000000
173	0.000000	173	0.000053
174	125.317292	174	0.000000
175	11.000000	175	0.000000
176	0.000000	176	0.011080
177	7.000000	177	0.000000
178	0.000000	178	0.009742
179	4.000000	179	0.000000
180	0.000000	180	0.011059
181	26.000000	181	0.000000
182	2.000000	182	0.000000
183	1.000000	183	0.000000
184	11.000000	184	0.000000
185	-0.000000	185	0.000000
186	0.000000	186	0.005242
187	24.000000	187	0.000000
188	0.000000	188	0.006732
189	0.000000	189	0.000010
190	9.705882	190	0.000000
191	6.294118	191	0.000000
192	3.000000	192	0.000000
193	24.000000	193	0.000000
194	40.000000	194	0.000000
195	5.000000	195	0.000000
196	1.000000	196	0.000000
197	13.000000	197	0.000000
198	0.000000	198	0.027643
199	0.000000	199	0.043099
200	8.000000	200	0.000000
201	0.000000	201	0.027633
202	0.000000	202	0.043099
203	1.000000	203	0.000000
204	1.000000	204	0.000000
205	1.000000	205	0.000000
206	1.000000	206	0.000000
207	2.000000	207	0.000000
208	7.000000	208	0.000000

Coordenada x	Valor x	Coordenada z	Valor z
209	2.000000	209	0.000000
210	2.000000	210	0.000000
211	2.000000	211	0.000000
212	1.000000	212	0.000000
213	2.000000	213	0.000000
214	5.000000	214	0.000000
215	2.000000	215	0.000000
216	21.000000	216	0.000000
217	13.000000	217	0.000000
218	6.000000	218	0.000000
219	7.000000	219	0.000000
220	17.000000	220	0.000000
221	25.000000	221	0.000000
222	6.294118	222	0.000000
223	0.000000	223	0.590330
224	-49.012862	224	0.000000
225	0.000000	225	0.279410
226	0.000000	226	-0.145510
227	0.000000	227	0.276640
228	-47.000000	228	0.070640
229	0.000000	229	0.163628
230	0.000000	230	-0.086372
231	0.000000	231	0.163000
232	-47.243540	232	0.000000
233	0.000000	233	0.132309
234	-81.000000	234	0.037309
235	0.000000	235	9.318763
236	0.000000	236	4.803831
237	0.000000	237	2.631432
238	0.000000	238	7.588255
239	0.000000	239	2.477058
240	2.355140	240	0.000000
241	0.000000	241	0.113894
242	0.160321	242	0.000000
243	0.721444	243	0.000000
244	0.280000	244	0.000000
245	0.000000	245	0.028396
246	0.000000	246	0.094658
247	0.085938	247	0.000000
248	0.838235	248	0.000000
249	0.075827	249	0.000000
250	0.000000	250	4.908524
251	0.000000	251	2.931095
252	0.000000	252	2.105952
253	0.000000	253	1.033871
254	0.000000	254	0.522503
255	0.000000	255	0.260950
256	0.000000	256	0.083207
257	0.000000	257	0.077134

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Coordenada x	Valor x	Coordenada z	Valor z
258	4.658015	258	0.000000
259	0.000000	259	0.000195
260	0.074881	260	0.000000
261	0.000000	261	0.002776
262	0.000000	262	0.061651
263	1.921948	263	0.000000
264	0.000000	264	1.269648
265	0.000000	265	0.673373
266	0.000000	266	0.368704
267	0.000000	267	0.076301
268	0.000000	268	0.149640
269	7.000000	269	-0.007597
270	0.000000	270	0.002274
271	3.085066	271	0.000000
272	0.695173	272	0.000000
273	0.000000	273	0.062747
274	3.897217	274	0.000000
275	0.000000	275	0.062469
276	1.510832	276	0.000000
277	0.000000	277	0.006356
278	0.000000	278	0.022252
279	0.000000	279	0.022336
280	2.417331	280	0.000000
281	0.000000	281	0.083204
282	0.000000	282	0.004219
283	0.000000	283	0.003377
284	0.924173	284	0.000000
285	0.000000	285	0.058283
286	0.000000	286	0.010904
287	1.691245	287	0.000000
288	0.222817	288	0.000000
289	0.000000	289	0.117214
290	0.704819	290	0.000000
291	0.159543	291	0.000000
292	2.135638	292	0.000000
293	0.000000	293	0.102420
294	0.000000	294	0.007011
295	0.700000	295	0.000000
296	3.300000	296	0.000000
297	0.000000	297	0.157181
298	0.000000	298	0.010044
299	0.000000	299	0.030287
300	0.161765	300	0.000000
301	0.000000	301	0.962734
302	0.000000	302	0.496810
303	0.000000	303	0.258647
304	0.000000	304	0.071536
305	0.000000	305	0.089666
306	1.196429	306	0.000000

Coordenada x	Valor x	Coordenada z	Valor z
307	0.000000	307	0.630869
308	0.000000	308	0.297180
309	0.000000	309	0.132685
310	0.234513	310	0.000000
311	0.765487	311	0.000000
312	0.222833	312	0.000000
313	0.000000	313	0.000305
314	0.000000	314	0.002520
315	0.000000	315	0.030369
316	3.200696	316	0.000000
317	0.000000	317	0.041270
318	0.664202	318	0.000000
319	0.000000	319	0.004992
320	0.000000	320	0.017817
321	0.000000	321	0.024136
322	2.453859	322	0.000000
323	-0.000000	323	0.000000
324	0.000000	324	28.386184
325	1.000000	325	0.000000
326	0.476744	326	0.000000
327	-0.000000	327	0.000000
328	0.523256	328	0.000000
329	1.000000	329	-0.428187
330	0.000000	330	1.312002
331	0.000000	331	0.622453
332	0.000000	332	0.326630
333	0.827465	333	0.000000
334	0.000000	334	0.032211
335	0.486036	335	0.000000
336	0.500477	336	0.000000
337	0.000000	337	0.059504
338	0.000000	338	0.026382
339	2.061996	339	0.000000
340	0.000000	340	5.834736
341	0.000000	341	1.900266
342	3.174784	342	0.000000
343	0.682768	343	0.000000
344	0.000000	344	0.003333
345	0.000000	345	0.061496
346	0.726937	346	0.000000
347	0.252983	347	0.000000
348	0.108333	348	0.000000
349	0.000000	349	0.201361
350	0.000000	350	0.369720
351	0.000000	351	0.058238
352	-0.000000	352	0.000000
353	0.238397	353	0.000000
354	1.271450	354	0.000000
355	0.000000	355	0.122615

Coordenada x	Valor x	Coordenada z	Valor z
356	2.077706	356	0.000000
357	0.000000	357	0.100193
358	0.000000	358	0.166277
359	9.513244	359	0.000000
360	8.856901	360	0.000000
361	0.000000	361	0.016149
362	20.000000	362	-0.043600
363	0.000000	363	0.100192
364	0.000000	364	0.150128
365	0.000000	365	0.043600
366	0.172535	366	0.000000
367	0.000000	367	0.472301
368	0.000000	368	0.786952
369	0.000000	369	6.729639
370	0.000000	370	2.186018
371	1.000000	371	0.000000
372	1.000000	372	0.000000
373	0.000000	373	6.527618
374	0.000000	374	2.084223
375	1.000000	375	0.000000
376	0.000000	376	0.005254
377	0.000000	377	0.054598
378	0.073187	378	0.000000
379	0.000000	379	0.347242
380	0.000000	380	0.161200
381	0.000000	381	0.065146
382	0.000000	382	0.000048
383	4.651904	383	0.000000
384	20.000000	384	-0.036499

3 Variáveis Duais (Multiplicadores de Lagrange)

Tabela 2: Variáveis duais do problema Boeing1

Coordenada y	Valor y
1	-0.000000
2	-0.000000
3	0.399557
4	-0.000000
5	-0.000000
6	-0.000000
7	-0.000000
8	-0.000000
9	-0.000000
10	-0.000000
11	-0.000000

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Coordenada y	Valor y
12	-0.133330
13	0.038590
14	-0.070640
15	0.086372
16	-0.000000
17	-0.037309
18	-0.000000
19	0.005483
20	-0.000000
21	0.047580
22	0.013301
23	0.051269
24	-0.000000
25	0.057318
26	-0.000000
27	0.052076
28	-0.000000
29	0.058809
30	0.045520
31	0.019858
32	0.006463
33	0.022608
34	0.013301
35	0.009256
36	0.027643
37	0.005483
38	0.022608
39	0.013301
40	0.024789
41	0.029098
42	-0.000000
43	0.029098
44	-0.000000
45	0.022608
46	0.008964
47	0.022608
48	0.008791
49	0.027643
50	-0.000000
51	0.006378
52	0.019364
53	0.005483
54	0.026338
55	0.018798
56	0.023444
57	-0.000000
58	0.133872
59	-0.000000
60	0.005483

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Coordenada y	Valor y
61	-0.000000
62	-0.000000
63	-0.000000
64	-0.000000
65	-0.000000
66	0.011978
67	-0.000000
68	-0.000000
69	0.022608
70	-0.000000
71	-0.000000
72	0.009534
73	0.022608
74	0.005483
75	-0.000000
76	-0.000000
77	0.005035
78	0.022608
79	-0.000000
80	-0.000000
81	0.005483
82	0.025770
83	0.024542
84	0.010696
85	0.008970
86	0.021552
87	0.030019
88	0.008970
89	-0.000000
90	0.010696
91	0.025770
92	0.018900
93	0.044712
94	0.008970
95	0.024595
96	0.010696
97	0.020681
98	0.030019
99	0.010696
100	0.008970
101	0.010696
102	0.008970
103	0.045520
104	-0.000000
105	-0.000000
106	-0.000000
107	0.052076
108	0.013301
109	-0.000000

Coordenada y	Valor y
110	0.027643
111	0.006722
112	0.013301
113	-0.000000
114	-0.000000
115	-0.000000
116	-0.000000
117	-0.169813
118	-0.130920
119	-0.080440
120	-0.134810
121	-0.299880
122	-0.258020
123	-0.019020
124	-0.073058
125	-0.035091
126	-0.014515
127	-0.030320
128	-0.026172
129	-0.021539
130	-0.076634
131	-0.250026
132	-0.259296
133	-0.058906
134	-0.057170
135	-0.054613
136	-0.025712
137	-0.025918
138	-0.030720
139	-0.028427
140	-0.017419
141	-0.278447
142	-0.239622
143	-0.024185
144	-0.026220
145	-0.222550
146	-0.213867
147	-0.031480
148	-0.014012
149	-0.022556
150	-0.024568
151	-0.232050
152	-0.223377
153	-0.018836
154	-0.018198
155	-0.020862
156	-0.275730
157	-0.222830
158	-0.013797

Coordenada y	Valor y
159	-0.269572
160	-0.215192
161	-0.019909
162	-0.071880
163	-0.271460
164	-0.218870
165	-0.052451
166	-0.033961
167	-0.019254
168	-0.039520
169	-0.056918
170	-0.030528
171	-0.134320
172	-0.121659
173	-0.120116
174	-0.026438
175	-0.222142
176	-0.276612
177	-0.071642
178	-0.070174
179	-0.071821
180	-0.075203
181	-0.085681
182	-0.082774
183	-0.227782
184	-0.281882
185	-0.250190
186	-0.259430
187	-0.220382
188	-0.229632
189	-0.217278
190	-0.216862
191	-0.226262
192	-0.208842
193	-0.263202
194	-0.226498
195	-0.221348
196	-0.275788
197	-0.233232
198	-0.220346
199	-0.274366
200	-0.278790
201	-0.286298
202	-0.270991
203	-0.228621
204	-0.241268
205	-0.230360
206	-0.000000
207	-0.006328

Coordenada y	Valor y
208	-0.006788
209	0.101117
210	0.549857
211	7.712595
212	-0.000000
213	-0.000000
214	-0.000000
215	-0.000000
216	-0.000000
217	-0.000000
218	0.204071
219	1.568059
220	-0.000000
221	-0.000000
222	-0.000000
223	-0.000000
224	0.253835
225	0.057486
226	-0.000000
227	-0.000000
228	33.151195
229	-0.000000
230	-0.000000
231	-0.000000
232	-0.000000
233	0.007267
234	0.113385
235	0.263372
236	-0.000000
237	-0.000000
238	-0.000000
239	-0.000000
240	-0.000000
241	-0.000000
242	-0.000000
243	-0.000000
244	-0.000000
245	-0.000000
246	-0.000000
247	-0.000000
248	-0.000000
249	-0.000000
250	-0.000000
251	0.087608
252	9.153065
253	1.506778
254	29.694619
255	-0.000000
256	-0.000000

Coordenada y	Valor y
257	-0.000000
258	-0.000000
259	-0.000000
260	-0.000000
261	-0.000000
262	-0.000000
263	-0.000000
264	-0.000000
265	0.004496
266	0.000807
267	-0.000000
268	-0.000000
269	0.075004
270	0.075004
271	0.055146
272	0.075004
273	0.080487
274	-0.000000
275	0.002894
276	-0.000000
277	-0.000000
278	-0.000000
279	-0.000000
280	-0.000000
281	-0.000000
282	0.002853
283	-0.000000
284	0.027643
285	0.015665
286	-0.000000
287	-0.000000
288	-0.000000
289	-0.000000
290	-0.000000
291	-0.000000
292	0.003767
293	0.008266
294	-0.000000
295	-0.000000
296	0.015665
297	-0.000000
298	-0.000000
299	-0.000000
300	0.000726
301	-0.000000
302	-0.000000
303	-0.000000
304	0.001455
305	-0.000000

Coordenada y	Valor y
306	0.002474
307	-0.000000
308	-0.000000
309	-0.000000
310	0.000567
311	-0.000000
312	-0.000000
313	-0.000000
314	-0.000000
315	0.186799
316	-0.000000
317	-0.000000
318	-0.000000
319	-0.000000
320	-0.000000
321	-0.000000
322	-0.000000
323	-0.000000
324	-0.000000
325	-0.000000
326	-0.000000
327	-0.000000
328	0.000980
329	0.003312
330	0.012748
331	0.053624
332	0.019607
333	-0.000000
334	-0.000000
335	-0.000000
336	-0.000000
337	-0.000000
338	-0.000000
339	-0.000000
340	-0.000000
341	-0.000000
342	-0.000000
343	0.004218
344	-0.000000
345	-0.000000
346	0.050312
347	0.005642
348	-0.000000
349	0.005642
350	-0.000000
351	0.003862

4 Observações

- O solver HiGHS foi configurado com o método IPM (Interior Point Method).

- Este arquivo contém a solução detalhada para o problema Boeing1.

- As variáveis duais representam os multiplicadores de Lagrange das restrições.

- Os custos reduzidos (z) indicam o impacto de forçar variáveis não-básicas na base.