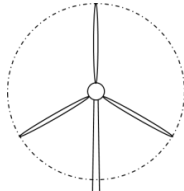
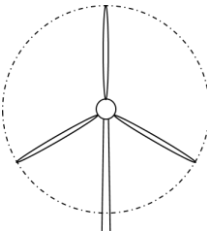
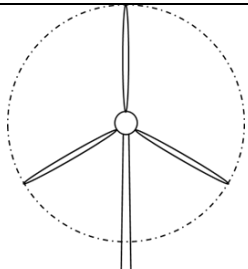


Assignment 1: Linear Programming

Investment Opportunity

A hedge fund has decided to invest in renewable energy resources. They have an opportunity to invest £100,000,000 (£100 million) in wind turbine technology and are now required to identify appropriate technology and locations. The investment firm has identified three promising wind turbine providers and the preferred products from these suppliers are given, below.

	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
			
Plot length per turbine (in a line), m	100	150	250
Life expectancy, years	20	20	20

The hedge fund manager is also seeking appropriate plots in which to situate the wind turbines. Again, there are three choices available and these are described as follows:

Location A:

Opportunity to install a single line of wind turbines on this agricultural land, with a total plot length of 5,000 metres



Location B:

Opportunity to install a single line of wind turbines along this hilltop, with a total plot length of 10,000 metres



Location C:

Opportunity to add more wind turbines to an existing windfarm that is located two miles offshore, with a total available plot length of 750 metres



Results from the Preliminary Survey

The hedge fund has already paid to have construction and meteorological surveys conducted to assess the cost and future performance of each wind turbine in each of the three locations. Please use your Employee ID from the Sensitivity Analysis assignment to gather the relevant earnings and cost data from the appendices at the end of this document. There is an annual earnings figure for each turbine, in each location; a combined purchase and installation cost for each turbine, in each location; and a land purchase cost for each turbine in each location.

Assignment Task

- Using the Simplex Method, identify how many of each wind turbine the hedge fund should install in each of the three locations. There are data tables at the end of this document that will give you unique information for you Employee ID number. Present your findings in the following tabular form:

<i>Employee ID = ##</i>	Turbine 1	Turbine 2	Turbine 3
Location A	?	?	?
Location B	?	?	?
Location C	?	?	?

- What will be the Return on Investment (RoI) for the hedge fund if they install the configuration, above, after 20 years, assuming this period is maintenance free period (no additional costs)?

$$RoI = \frac{\text{Generated Income} - \text{Cost of Investment}}{\text{Cost of Investment}}$$

Appendix A – Annual earnings for each turbine, in each location

Employee ID	Location A			Location B			Location C		
	Turbine 1	Turbine 2	Turbine 3	Turbine 1	Turbine 2	Turbine 3	Turbine 1	Turbine 2	Turbine 3
1	£ 138,300	£ 318,300	£ 320,400	£ 243,570	£ 421,360	£ 45,494	£ 248,875	£ 531,900	£ 1,488,000
2	£ 161,850	£ 302,400	£ 317,400	£ 222,640	£ 500,020	£ 44,160	£ 271,150	£ 552,960	£ 1,588,500
3	£ 160,650	£ 317,400	£ 301,500	£ 209,990	£ 501,400	£ 48,438	£ 282,425	£ 487,080	£ 1,590,000
4	£ 159,900	£ 310,800	£ 293,700	£ 249,320	£ 465,980	£ 42,734	£ 268,675	£ 567,000	£ 1,389,000
5	£ 163,650	£ 326,100	£ 296,100	£ 216,660	£ 418,140	£ 44,574	£ 266,750	£ 552,420	£ 1,549,500
6	£ 136,200	£ 300,600	£ 294,900	£ 249,780	£ 469,660	£ 50,462	£ 269,225	£ 511,920	£ 1,411,500
7	£ 164,850	£ 294,900	£ 270,600	£ 214,360	£ 484,380	£ 45,172	£ 301,950	£ 548,640	£ 1,366,500
8	£ 154,950	£ 305,700	£ 285,000	£ 234,370	£ 439,300	£ 49,404	£ 255,750	£ 530,820	£ 1,636,500
9	£ 147,750	£ 271,500	£ 274,500	£ 223,330	£ 427,340	£ 41,768	£ 267,850	£ 514,620	£ 1,630,500
10	£ 164,100	£ 314,100	£ 320,400	£ 224,480	£ 465,520	£ 48,576	£ 276,100	£ 541,080	£ 1,431,000
11	£ 138,750	£ 291,300	£ 325,500	£ 207,460	£ 498,180	£ 49,864	£ 296,725	£ 489,780	£ 1,629,000
12	£ 153,600	£ 280,500	£ 319,200	£ 207,000	£ 414,000	£ 49,772	£ 283,525	£ 556,200	£ 1,461,000
13	£ 145,950	£ 317,400	£ 279,600	£ 242,190	£ 432,400	£ 48,254	£ 264,275	£ 586,440	£ 1,410,000
14	£ 139,350	£ 322,200	£ 287,700	£ 215,280	£ 454,940	£ 43,608	£ 290,675	£ 554,580	£ 1,494,000
15	£ 145,650	£ 284,700	£ 309,900	£ 218,040	£ 472,880	£ 44,022	£ 249,150	£ 571,320	£ 1,437,000
16	£ 137,550	£ 314,700	£ 329,400	£ 228,620	£ 436,540	£ 45,632	£ 266,200	£ 564,840	£ 1,576,500
17	£ 139,350	£ 273,600	£ 317,700	£ 211,370	£ 459,080	£ 46,644	£ 291,775	£ 573,480	£ 1,638,000
18	£ 142,950	£ 286,500	£ 276,900	£ 224,710	£ 454,940	£ 48,070	£ 273,625	£ 571,320	£ 1,447,500
19	£ 140,250	£ 303,000	£ 290,700	£ 221,030	£ 480,700	£ 50,278	£ 265,100	£ 550,800	£ 1,446,000
20	£ 135,750	£ 322,500	£ 288,600	£ 238,280	£ 453,560	£ 43,562	£ 282,425	£ 576,180	£ 1,371,000
21	£ 148,950	£ 286,200	£ 326,400	£ 221,950	£ 441,140	£ 47,104	£ 252,725	£ 577,800	£ 1,455,000
22	£ 161,700	£ 314,700	£ 287,400	£ 224,480	£ 434,240	£ 48,024	£ 248,050	£ 592,920	£ 1,434,000

Appendix B – Purchase and installation cost of each turbine, in each location

Employee ID	Location A			Location B			Location C		
	Turbine 1	Turbine 2	Turbine 3	Turbine 1	Turbine 2	Turbine 3	Turbine 1	Turbine 2	Turbine 3
1	£ 75,030	£ 310,860	£ 3,379,200	£ 2,710,800	£ 3,603,800	£ 4,493,300	£ 3,766,600	£ 4,459,000	£ 6,619,800
2	£ 85,116	£ 363,000	£ 3,045,900	£ 2,859,300	£ 3,799,900	£ 4,929,400	£ 3,744,400	£ 5,228,300	£ 6,553,800
3	£ 83,476	£ 333,960	£ 3,138,300	£ 2,883,600	£ 3,392,900	£ 5,336,100	£ 3,333,700	£ 5,360,600	£ 6,870,600
4	£ 82,492	£ 318,450	£ 3,405,600	£ 2,494,800	£ 3,792,500	£ 5,233,200	£ 3,740,700	£ 5,198,900	£ 6,883,800
5	£ 87,248	£ 357,720	£ 3,214,200	£ 2,932,200	£ 3,555,700	£ 4,586,400	£ 3,566,800	£ 5,145,000	£ 7,240,200
6	£ 82,082	£ 323,400	£ 3,154,800	£ 2,627,100	£ 4,070,000	£ 4,522,700	£ 3,633,400	£ 5,296,900	£ 6,349,200
7	£ 74,866	£ 338,910	£ 2,979,900	£ 2,775,600	£ 4,025,600	£ 5,336,100	£ 3,970,100	£ 4,885,300	£ 7,114,800
8	£ 80,360	£ 359,040	£ 3,531,000	£ 2,592,000	£ 4,040,400	£ 4,586,400	£ 3,392,900	£ 4,601,100	£ 6,507,600
9	£ 88,068	£ 361,680	£ 3,603,600	£ 2,624,400	£ 3,552,000	£ 5,247,900	£ 3,885,000	£ 4,601,100	£ 6,164,400
10	£ 89,790	£ 302,280	£ 3,346,200	£ 2,540,700	£ 3,707,400	£ 4,444,300	£ 3,396,600	£ 4,444,300	£ 6,065,400
11	£ 86,346	£ 313,170	£ 3,144,900	£ 2,916,000	£ 3,426,200	£ 5,120,500	£ 3,696,300	£ 4,424,700	£ 6,534,000
12	£ 78,392	£ 361,020	£ 3,379,200	£ 2,767,500	£ 3,404,000	£ 5,316,500	£ 3,537,200	£ 5,100,900	£ 6,850,800
13	£ 80,524	£ 347,490	£ 3,501,300	£ 2,497,500	£ 3,951,600	£ 5,194,000	£ 4,003,400	£ 4,527,600	£ 7,154,400
14	£ 83,066	£ 334,290	£ 3,065,700	£ 2,592,000	£ 3,888,700	£ 4,512,900	£ 4,007,100	£ 4,689,300	£ 7,227,000
15	£ 77,244	£ 346,830	£ 3,276,900	£ 2,583,900	£ 3,415,100	£ 4,713,800	£ 4,007,100	£ 4,914,700	£ 7,260,000
16	£ 77,162	£ 298,320	£ 3,257,100	£ 2,594,700	£ 3,899,800	£ 5,282,200	£ 4,062,600	£ 5,091,100	£ 6,903,600
17	£ 80,524	£ 313,170	£ 2,970,000	£ 2,683,800	£ 3,740,700	£ 5,301,800	£ 3,929,400	£ 4,870,600	£ 6,923,400
18	£ 76,424	£ 362,340	£ 3,082,200	£ 2,762,100	£ 3,714,800	£ 4,713,800	£ 3,959,000	£ 5,228,300	£ 6,006,000
19	£ 87,330	£ 318,780	£ 3,260,400	£ 2,616,300	£ 3,337,400	£ 4,454,100	£ 4,051,500	£ 4,934,300	£ 6,091,800
20	£ 81,262	£ 327,690	£ 3,135,000	£ 2,484,000	£ 3,892,400	£ 4,978,400	£ 3,981,200	£ 4,939,200	£ 6,336,000
21	£ 77,162	£ 298,650	£ 3,303,300	£ 2,754,000	£ 3,892,400	£ 4,625,600	£ 3,870,200	£ 4,738,300	£ 6,402,000
22	£ 86,100	£ 334,950	£ 3,356,100	£ 2,559,600	£ 3,777,700	£ 5,145,000	£ 4,070,000	£ 4,836,300	£ 6,138,000

Appendix C – Land cost for each turbine, in each location

Employee ID	Location A			Location B			Location C		
	Turbine 1	Turbine 2	Turbine 3	Turbine 1	Turbine 2	Turbine 3	Turbine 1	Turbine 2	Turbine 3
1	£ 191,400	£ 756,750	£ 1,193,750	£ 310,200	£ 1,058,625	£ 1,800,000	£ 486,900	£ 5,115,600	£ 3,063,200
2	£ 208,600	£ 780,750	£ 1,258,750	£ 309,000	£ 1,065,375	£ 2,004,375	£ 446,850	£ 5,341,000	£ 2,780,400
3	£ 197,200	£ 772,500	£ 1,240,000	£ 301,800	£ 1,060,875	£ 1,938,750	£ 493,200	£ 5,228,300	£ 2,954,000
4	£ 183,000	£ 711,000	£ 1,372,500	£ 313,500	£ 1,154,250	£ 1,848,750	£ 458,550	£ 4,414,900	£ 3,052,000
5	£ 198,600	£ 773,250	£ 1,137,500	£ 314,700	£ 1,062,000	£ 1,903,125	£ 413,550	£ 5,071,500	£ 2,965,200
6	£ 201,800	£ 694,500	£ 1,182,500	£ 276,900	£ 1,138,500	£ 1,833,750	£ 435,600	£ 5,091,100	£ 2,587,200
7	£ 184,800	£ 768,000	£ 1,228,750	£ 312,900	£ 1,216,125	£ 1,828,125	£ 455,850	£ 5,203,800	£ 2,912,000
8	£ 205,600	£ 701,250	£ 1,180,000	£ 309,900	£ 1,108,125	£ 1,747,500	£ 474,750	£ 5,213,600	£ 2,914,800
9	£ 214,800	£ 751,500	£ 1,211,250	£ 299,100	£ 1,102,500	£ 2,002,500	£ 452,700	£ 4,571,700	£ 3,040,800
10	£ 191,200	£ 717,000	£ 1,358,750	£ 317,700	£ 1,095,750	£ 1,867,500	£ 452,700	£ 5,194,000	£ 2,609,600
11	£ 200,600	£ 734,250	£ 1,331,250	£ 316,800	£ 1,109,250	£ 1,906,875	£ 479,700	£ 4,797,100	£ 3,040,800
12	£ 210,000	£ 780,750	£ 1,373,750	£ 309,600	£ 1,055,250	£ 1,935,000	£ 415,350	£ 5,385,100	£ 2,864,400
13	£ 219,800	£ 684,750	£ 1,297,500	£ 290,100	£ 1,067,625	£ 1,779,375	£ 472,500	£ 5,145,000	£ 2,615,200
14	£ 219,600	£ 807,750	£ 1,262,500	£ 280,500	£ 1,180,125	£ 2,002,500	£ 433,800	£ 4,895,100	£ 2,864,400
15	£ 193,600	£ 705,000	£ 1,373,750	£ 294,000	£ 1,099,125	£ 1,687,500	£ 428,400	£ 4,787,300	£ 2,951,200
16	£ 198,400	£ 684,750	£ 1,292,500	£ 318,600	£ 1,024,875	£ 1,860,000	£ 413,550	£ 4,424,700	£ 2,550,800
17	£ 213,200	£ 714,000	£ 1,168,750	£ 270,300	£ 1,183,500	£ 1,796,250	£ 490,050	£ 5,100,900	£ 2,970,800
18	£ 192,200	£ 740,250	£ 1,235,000	£ 290,700	£ 1,164,375	£ 1,995,000	£ 467,550	£ 5,037,200	£ 2,954,000
19	£ 211,600	£ 734,250	£ 1,283,750	£ 279,900	£ 1,067,625	£ 1,895,625	£ 423,900	£ 4,552,100	£ 2,942,800
20	£ 180,800	£ 780,000	£ 1,151,250	£ 273,600	£ 1,121,625	£ 1,741,875	£ 453,150	£ 4,478,600	£ 2,744,000
21	£ 219,400	£ 733,500	£ 1,267,500	£ 310,500	£ 1,230,750	£ 1,878,750	£ 474,300	£ 5,267,500	£ 2,595,600
22	£ 196,200	£ 747,750	£ 1,283,750	£ 272,100	£ 1,159,875	£ 1,711,875	£ 422,550	£ 5,306,700	£ 2,671,200