Task 1 Report - Nathan Morales (1873615)

Run 1: P = 80 z = 0.1 Run 2: p = 50 z = 0.05	Run 1			Run 2		
	Solutions Searched	Best Sol	f(BestSol)	Solutions Searched	Best Sol	f(BestSol)
Run 1: (2, 2) Run 2: (3, 1)	2561	(2.958266238627721, 0.4893570952347443 5)	f(x, y): 0.0002923898343034236	501	Local Min: (3.188747004456526, 0.5436649216349422)	f(x, y): 0.0046627088354723395
Run 1: (1, 4) Run 2: (1, 1)	6161	Local Min: (-3.551341395381286 2, 1.227334827557689)	f(x, y): 0.835480782440896	3401	Local Min: (2.998276932150498, 0.49980340909227)	f(x, y): 1.7041158757197887e-06
Run 1: (-2, -3) Run 2: (-1, 4)	3761	Local Min: (-3.3871304780371703, 1.2357726957477642)	f(x, y): 0.8521813352562098	1351	Local Min: (-0.12593146229897745, 2.9333570143363845)	f(x, y): 3.4318760946315483
Run 1: (1, -2) Run 2: (4, -3)	3201	Local Min: (3.0045707703378057, 0.5018732894981062)	f(x, y): 1.6120536846400875e-05	4951	Local Min: (3.0056212593421 03, 0.5022891847257881)	f(x, y): 2.3817260545034985e-05

Run 1: P = 80, z = 0.02 Run 2: P = 50 Z = 0.2	Run 1			Run 2		
	Solutions Searched	Best Sol	f(BestSol)	Solutions Searched	Best Sol	f(BestSol)
Run 1: (2, 2) Run 2: (3, 1)	12241	Local Min: (2.992503817286353 4, 0.498088870336099)	f(x, y): 9.119001945134514e-06	151	Local Min: (3.264286503214368 , 0.5544186534330194)	f(x, y): 0.009077116159386014
Run 1: (1, 4) Run 2: (1, 1)	29041	Local Min: (-4.683740801256413 , 1.1799789033516384)	f(x, y): 0.750992627829723	951	Local Min: (3.0230786071297024 , 0.5083501685934151)	f(x, y): 0.000255029051185923 54
Run 1: (-2, -3) Run 2: (-1, 4)	22881	Local Min: (-4.768035604852979 , 1.1772002341592078)	f(x, y): 0.746170927024777	351	Local Min: (-0.12425541080728009 , 2.9098180836968304)	f(x, y): 3.439959618879127
Run 1: (1, -2) Run 2: (4, -3)	14961	Local Min: (2.996133428368671 6, 0.499005996657357)	f(x, y): 2.429303409940951e-06	1251	Local Min: (3.038292165824935 , 0.5086413745198977)	f(x, y): 0.000237039644292285552

Run 1: P = 500 z = 0.1 Run 2: P = 350 Z = 0.05	Run 1			Run 2		
	Solutions Searched	Best Sol	f(BestSol)	Solutions Searched	Best Sol	f(BestSol)
Run 1: (2, 2) Run 2: (3, 1)	15501	Local Min: (2.994112244767018, 0.4981590401453449 6)	f(x, y): 8.84202482109875e-06	6301	Local Min: (3.000621229461946, 0.4996635690205745)	f(x, y): 5.609083626267342e-06
Run 1: (1, 4) Run 2: (1, 1)	88001	Local Min: (-13.624598021258105, 1.0680515036576241)	f(x, y): 0.5612950540113466	14701	Local Min: (2.9915183665485787, 0.497742128747665)	f(x, y): 1.2118191680915733e-05
Run 1: (-2, -3) Run 2: (-1, 4)	85001	Local Min: (-14.037125215271269, 1.0661076651061658)	f(x, y): 0.5583307096319872	79801	Local Min: (-9.0277467581684, 1.0998897673923427)	f(x, y): 0.6141540240194218
Run 1: (1, -2) Run 2: (4, -3)	17001	Local Min: (2.994980794934389, 0.5004028184343723)	f(x, y): 6.658498758289785e-05	28701	Local Min: (3.0028758086947196, 0.5002535467169392)	f(x, y): 6.187632813274816e-06

Run 1: P = 500 z = 0.02 Run 2: P = 350 Z = 0.2	Run 1			Run 2		
	Solutions Searched	Best Sol	f(BestSol)	Solutions Searched	Best Sol	f(BestSol)
Run 1: (2, 2) Run 2: (3, 1)	77501	Local Min: (2.999384481001350 4, 0.5000405 526268065)	f(x, y): 9.2125218 9263123e-07	1401	Local Min: (2.9781106 49637857, 0.4952748 450943214)	f(x, y): 9.1260871 42048792e-05
Run 1: (1, 4) Run 2: (1, 1)	535501	Local Min: (-17.83633 831722265 5, 1.0529281 355029196)	f(x, y): 0.5357639 568116457	4201	Local Min: (3.001460 592131571 , 0.4986586 183892949)	f(x, y): 6.7198140 64390301e-05
Run 1: (-2, -3) Run 2: (-1, 4)	503001	Local Min: (-17.84215 781129526 6, 1.0529126 114611405)	f(x, y): 0.5357366 877249442	17501	Local Min: (-7.399923 361565512 , 1.1189046 246393308)	f(x, y): 0.6494910 466656552
Run 1: (1, -2) Run 2: (4, -3)	79501	Local Min: (2.999840 854501859 8, 0.5000363 155794079)	f(x, y): 1.3648522 568595011 e-07	7001	Local Min: (2.961389 469565778 , 0.4915108 671027112 5)	f(x, y): 0.0002827 897089454 657

Seed used for Run 1: 800
Seed used for Run 2: 450

sp values for Run 2: (3, 1), (1, 1), (-1, 4), (4, -3)
P - values used for Run 2: 50 & 350
Z - values used for Run 2: 0.05 & 0.2

Analysis:
When looking at the run 1 data set we can clearly see that there were a few values of the best solution that were outside the designated value range (-4.5, 4.5). 6 in total in the run 1 data set. However in the run 2 data set with the different sp, p, and z values we can see that there were only 2 outliers outside of the designated value range. This indicates that the preferred values that I chose were significantly better at determining the local minimum. The algorithm speed however did take significantly longer as I had to reset the recursion limit for my program as it had many more recursive calls once I ran the program with my preferred values. Which leads me to my next point: my solution for this problem was done recursively. It would recursively call the RHC function until the minimum f(x, y) of all neighboring solutions was not lower than the current best solution. As far as solution quality we can see that the solutions that were given with my values have much higher quality as there are less values outside the data range. I believe there are some values p and z that will produce better results however we do have to take into consideration the seed as it does also change the solutions given. Once we changed to my values the quality of our solutions was higher. So I believe this therefore clarifies there is some p and z value that will produce optimal results. Overall I do believe that RHC did a medium job in computing a local minimum for f and do believe the results could be better depending on a few factors as discussed above.

Source Code: Acquired from ChatGPT. Helped me get started and provided a foundation for me to create my solution.
(The power of AI)