

# Readme 说明

崔诗颖 2017.8.28

1. 该回测系统具有更高的可拓展性和鲁棒性，后期可根据喜好继续改进
  - 带入参数  $n_1, n_2, n_3$  可随意调节，在衡量策略的函数 **assess function** 中，用无量纲化后的年化收益率与最大回撤的线性组合作为度量，其中  $k$  值可根据投资者的喜好任意调节：
  - $K$  值越小，证明投资者越偏好高收益，对风险考虑更少
  - 在寻找最优参数时，默认的  $K$  值为 1
  - 对无量纲化的说明：为了防止牛市、熊市对策略的影响，此处无量纲化的方法是，  
(将择时策略的年化收益率+1) / (无策略时的年化收益率+1)
2. 寻找最优参数情况说明：  
In-sample 选取：2006-2014 out-sample 选取：2015-2017  
针对 SZ50, HS300, ZZ500, ZZ800 分别计算出 in-sample 的 **assess function** 并保存到数组中，对数组从高到低排序，选取最高值的  $n_1, n_2, n_3$ ，并带入 out-sample 中观察 out-sample 的表现情况
3. 情况说明：

## SZ50:

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[200.90409477645855, 108.54557437948564, 45.846124066145926, 34.530621144324584, 20.702943487894, 16.162345126665137, 15.255108775627464,
11.856900370199391, 11.524113568984344, 10.899659650949459, 9.718000799553014, 8.7667836669076227, 6.9141380602613793, 6.6079361986854588,
6.0895876984325295, 5.8740515213507161, 5.6860525398302419, 5.5215593085183441, 5.3298174247301286, 5.1498029802952976, 4
.9829804780027755, 4.8024814310457602, 4.7544513386993383, 4.5010922761739192, 4.2542732725366488, 3.9526780872947569, 3.7873284130111124,
3.6191563495540628, 3.3361088923128417, 3.1494033293504509, 2.7375865043494825, 2.5941129847327842, 2.5818025265595015, 2
.5204320429426215, 2.5097424932904979, 2.486985668549091, 2.4587266337406399, 2.4553614855153723, 2.4399296398773442, 2.2670651746075854,
2.2418281812802494, 2.2276166817444221, 2.1702888692884712, 2.1645696483520389, 2.1452169240441972, 2.1350866349461786, 2
.1271698032472148, 2.0854396079670194, 2.0778414751050178, 2.050329202100429, 2.03499637055556, 1.9594778245994928, 1.8037959245903759,
1.7966547967911275, 1.7577967038496785, 1.7050982126421417, 1.6995731385221229, 1.6862649628219351, 1.6759331730535401, 1
.6716887472437731, 1.6685425215801812, 1.637557782731637, 1.6089781800724938, 1.6063123688550136, 1.5927576058289363, 1.5847665206935475,
1.5738247684575253, 1.5705631831755773, 1.5454479881843814, 1.5423872916624848, 1.5331550602041384, 1.5255807850364667, 1
.5160176571794504, 1.4924281086661761, 1.4909357918733397, 1.4768018730307386, 1.4710799711562166, 1.4689338752410181, 1.4482468655387681,
1.4341852594353646, 1.4283715754015698, 1.4269455966764142, 1.4167350186939283, 1.4136652567531138, 1.4042635362393294, 1
.3983634208864708, 1.3717896818995599, 1.3679560277260121, 1.3653009030237593, 1.3393600690438627, 1.3391242946671658, 1.3353016826861666,
1.3123328917222175, 1.2800497916071867, 1.262083137997613, 1.2514119462007978, 1.2509928154205223, 1.2402954634952859, 1.235365994651082,
1.2351674253892528, 1.2186827337195936, 1.2070689601113731, 1.1665049042066529, 1.1575368739925571, 1.1531057988778783, 1
.1335440358627871, 1.123957651067264, 1.1158641436561045, 1.107540242103501, 1.103649961036913, 1.0933437700889543, 1.0882709238695087,
1.0788681817921673, 1.0698103692337875, 1.0629024920427694, 1.0551454822361186, 1.0549991209299603, 1.0460547836617071, 1
.0416788945373363, 1.0387418999987492, 1.0339349431740352, 1.0335428955459565, 1.0254036331264553, 1.0240186397684168, 1.020247698842397]
[2, 2, 4, 3, 2, 4, 2, 4, 3, 4, 4, 3, 3, 2, 4, 4, 5, 2, 6, 3, 6, 6, 3, 2, 5, 4, 4, 4, 4, 4, 6, 6, 2, 4, 3, 6, 5, 3, 5, 5, 6, 3, 5, 5, 3, 2,
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[6, 4, 4, 4, 3, 4, 5, 4, 4, 5, 6, 6, 3, 4, 5, 3, 4, 4, 4, 6, 4, 5, 2, 4, 4, 3, 4, 6, 5, 2, 5, 5, 5, 2, 3, 4, 5, 5, 6, 4, 3, 5, 3, 6, 3,
6, 5, 4, 4, 5, 6, 3, 3, 4, 3, 2, 4, 5, 5, 5, 6, 2, 3, 6, 5, 6, 5, 4, 6, 5, 5, 2, 2, 2, 6, 4, 6, 6, 6, 5, 2, 3, 3, 4, 3, 6, 3, 5,
6, 5, 3, 3, 2, 2, 3, 3, 6, 6, 3, 2, 6, 3, 6, 2, 3, 2, 2, 2, 2, 3, 5, 2, 2, 2, 4, 2, 6, 3, 2, 2]
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从运行结果可看出，最大的 assess function 是 200，对应的 $[n_1, n_2, n_3]$ 为 $[2, 2, 6]$

选择前 10 的参数看其 out-sample 情况,发现 out-sample 的得分普遍不高,证明 1. 2015 年股灾导致得分普遍不高; 2. assess func 用的是全样本的年化收益与最大回撤,可以说年限越长, assess func 的得分会越稳定, out-sample 只有 3 年且其中一年都处于股灾,因此会导致所有的 out-sample 得分都远远低于 in-sample

[2,2,6]	[2,2,4]	[4,2,4]	[3,2,4]	[2,2,3]
2.10632407529	6.75625136786	4.91434666556	5.30781784517	3.72035676825
[4,3,4]	[2,2,5]	[4,4,4]	[3,3,4]	[4,2,5]
2.16149838875	3.37455941309	2.42632207299	2.86130999127	2.44073827298

Chart: SZ 50 out-sample assess function

HS 300 :

[3478. 4900486009442, 2576. 2203475553392, 1212. 6454876056434, 610. 84412168347247, 247. 62582340804934, 142. 70006607546017, 134. 47882055949847, 130. 03163096617965, 100. 53474708475296, 99. 450832358284387, 81. 126795024440298, 77. 583325118292024, 75. 842291050115364, 68. 07447325588133, 63. 579385180061571, 60. 434801517160921, 56. 09517044505094, 55. 265717036519055, 38. 647075380588227, 35. 736700134299852, 33. 728894647126275, 29. 023703257225375, 26. 011582485727853, 14. 014265039502162, 12. 881795889933436, 10. 673393267105581, 7. 6898892098832121, 7. 4228651048417218, 5. 740252163951051, 5. 6567830987862349, 5. 4655589129126919, 5. 0859459781023038, 5. 0800044972375513, 4. 4994538384215721, 4. 3404313847037379, 4. 314839853076597, 4. 2546195206588138, 3. 7158316340929698, 3. 698258956737047, 3. 5102556251705828, 3. 2967490268526491, 3. 2153255106247944, 3. 0073824396971265, 2. 6948607393781847, 2. 5032432846546904, 2. 4888361346012573, 2. 4536854008310813, 2. 4182964664581368, 2. 4060745339426716, 2. 28729666769699434, 2. 2428307106859722, 2. 2370904588072928, 2. 1840138780389671, 2. 1658429915739372, 1. 9275432575467959, 1. 8263772336085151, 1. 76067274551122093, 1. 759297891834774, 1. 7084011827447481, 1. 677582686907519, 1. 5362945682809774, 1. 5244887831664116, 1. 4995229806216428, 1. 4968513470833321, 1. 4896481042075533, 1. 4530168903969396, 1. 4310682712293197, 1. 4250778605664918, 1. 4206734052225207, 1. 3953785305937259, 1. 3768288495746233, 1. 3558861635351747, 1. 3548071549919722, 1. 3537445197602984, 1. 3496296560476717, 1. 3410900636673502, 1. 3333822742203698, 1. 3252140365155609, 1. 3244989779126546, 1. 3223780393334888, 1. 313170109982485, 1. 291824907079766, 1. 2870924162717681, 1. 2703656696378336, 1. 2669256965230999, 1. 2211715528123543, 1. 1952510764641632, 1. 187193841003255, 1. 1842249086144758, 1. 162356109096098, 1. 153617802712452, 1. 1523144229908546, 1. 1384922013180652, 1. 1279080069166441, 1. 1241730700861321, 1. 1080332993955215, 1. 0988626352737771, 1. 0986922248884028, 1. 0946258230527113, 1. 088428353316303, 1. 0832776128376658, 1. 0758404702397077, 1. 074938101904632, 1. 072836222086838, 1. 0724567314996489, 1. 0659101128449615, 1. 0640646729198218, 1. 0614284903615776, 1. 0602807512943522, 1. 0597867836930395, 1. 0571964455821589, 1. 0480280928431089, 1. 0470583037347336, 1. 046291262952296, 1. 0461977165117111, 1. 0433903891067533, 1. 0413934104223823, 1. 04129648338333491, 1. 0410368102731467, 1. 0401660290330097, 1. 0386838928129494, 1. 0196317362146208, 1. 0185809977367425, 1. 01625271715830396, 1. 0140363626464266]

[3, 3, 2, 2, 4, 5, 4, 2, 5, 4, 5, 6, 2, 4, 6, 3, 2, 3, 6, 2, 3, 3, 4, 2, 2, 5, 2, 5, 6, 5, 3, 3, 6, 4, 6, 6, 4, 3, 2, 3, 5, 5, 5, 4, 2, 6, 2, 2, 6, 6, 6, 2, 3, 5, 6, 3, 6, 3, 6, 3, 5, 4, 3, 6, 4, 6, 5, 5, 4, 4, 6, 6, 2, 4, 3, 5, 4, 5, 4, 3, 2, 3, 5, 6, 5, 2, 4, 6, 2, 6, 4, 4, 5, 3, 5, 4, 5, 6, 6, 3, 2, 3, 6, 6, 4, 4, 3, 3, 2, 2, 5, 6, 2, 4, 6, 5, 5, 2, 2, 3, 4, 3, 5]

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从运行结果可看出，最大的 assess function 是 3478，对应的[n1,n2,n3]为**[3,2,6]**

[3,2,6]	[3,2,5]	[2,2,4]	[2,2,5]	[4,2,5]
2.33734069933	2.47821506646	2.71243549517	2.02739824971	2.43268532037
[5,2,4]	[4,2,6]	[2,3,6]	[5,2,6]	[4,3,4]
2.56327947048	2.12986202569	2.04590992997	2.23102116438	2.92757211175

Chart: HS 300 out-sample assess function

HS\_500:

[240.39217643856296, 138.40737517529138, 101.73367205018572, 81.128955041722506, 62.766724977096551, 48.719966203721874, 33.85582522485776, 33.501851850567924, 31.163249605008279, 30.524548924391908, 23.871511311633522, 22.674326171053465, 21.992465982764564, 21.35456156530492, 19.804219736492911, 19.649055195549284, 18.672894980389209, 17.523622945691958, 17.37663440388588, 14.961489002754867, 12.573049290741848, 11.780787816055232, 11.250989279283058, 10.707874508650004, 10.195274088971816, 9.4092231742242269, 9.3622294165375806, 9.2473006418957464, 8.852859703098455, 8.797692486977617, 8.6365977932333635, 8.1821611238213823, 8.1190538960508718, 8.006909068655407, 7.9660896477538952, 7.8968631465834127, 7.8493131801878953, 7.6072294479089315, 7.0877133007254018, 6.8456623815022661, 6.5591198696676329, 6.2298281040861054, 5.7306558786347459, 5.7133262807806808, 5.6335787980569956, 5.6186501031476288, 5.2327373685757639, 5.1956584991702535, 4.8945570581635973, 4.7017766757234902, 4.6782684523589175, 4.6770968690241173, 4.6640367812695054, 4.2105602925252867, 4.1439288871909001, 4.045704115893062, 3.6897676543117162, 3.6816297327812406, 3.6642141399402948, 3.5868560092775374, 3.5825595356980986, 3.476522580251292, 3.4212957661557937, 3.3405165817175693, 3.3001668775859545, 3.2992660634905968, 3.1694279295817038, 3.1551901578598605, 3.139511504929684, 3.1064941030302529, 2.9479732905526057, 2.7864394698849964, 2.728739932223002, 2.7193671767539813, 2.686548841846248, 2.6814206244264973, 2.6451308807106488, 2.5457785623816651, 2.3348421877999463, 2.2962142764798283, 2.2478729931380252, 2.2040695312586736, 2.1153866588408068, 2.1115976033170476, 1.9815391899244266, 1.9643080167587901, 1.9013609552965915, 1.848643117687188, 1.8296905137577322, 1.719792778338866, 1.711880777492595, 1.6771623949721994, 1.5621971853269485, 1.5365393501803579, 1.4390919643678486, 1.4159900092968987, 1.3945691582863211, 1.3520609759019375, 1.3321367536258624, 1.3119767542784804, 1.3011044679154111, 1.2954635096845355, 1.2847240390436161, 1.279978553823691, 1.1995802959371906, 1.1681945141698642, 1.1652137338466155, 1.1644772449626406, 1.1608532565521041, 1.1287601562629528, 1.1163108137589042, 1.1131739462652437, 1.0922193612595408, 1.0798258195700678, 1.0493682584387862, 1.0474072490670367, 1.0381477464177242, 1.0026833575026124, 1.0015209748494038, 1.0014033836699943, 1.0004768315246997, 1.000125747902699, 1.0000627580675219, 1.0000226306714608, 1.0000202409287882]

[3, 3, 3, 4, 6, 5, 6, 2, 4, 5, 5, 6, 5, 6, 5, 2, 3, 6, 4, 5, 4, 2, 2, 6, 3, 2, 6, 3, 5, 2, 4, 6, 6, 5, 6, 2, 2, 3, 4, 4, 5, 6, 6, 6, 6, 2, 4, 3, 6, 3, 5, 2, 4, 5, 6, 4, 2, 4, 3, 3, 5, 6, 4, 4, 2, 3, 4, 3, 5, 5, 6, 6, 2, 5, 4, 4, 5, 3, 6, 6, 5, 3, 2, 5, 4, 4, 2, 3, 6, 2, 6, 3, 4, 6, 3, 4, 4, 5, 5, 5, 4, 3, 2, 4, 5, 2, 2, 2, 3, 3, 2, 4, 5, 3, 2, 2, 2, 4, 2, 5, 3]

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其最佳参数为[3,2,5]

[3,2,5]	[3,2,6]	[3,3,6]	[4,2,6]	[6,3,6]
2.65474238765	2.32528103952	2.40420734329	2.29350090118	2.09995422567
[5,2,6]	[6,4,6]	[2,3,6]	[4,3,6]	[5,3,4]
2.1502770224	1.75204717677	1.94361370548	2.50875022167	2.95718258094

Chart: HS\_500 out-sample assess function

HS\_800 :

[25872.172360454944, 1848.5067367174181, 1585.8409734630022, 991.72011144545468, 731.59915678698655, 674.37868815771594, 576.26423085207284, 530.91494101505191, 508.72022087502467, 387.10624420185763, 345.37138398168014, 320.43278139372705, 299.73499564309805, 281.95522931763594, 237.03928159947216, 216.23427675379077, 189.87891824135323, 189.46752214221462, 172.75018514129468, 165.29300560607945, 139.892489048257, 123.89924748280492, 66.351381184144742, 62.263044981585452, 54.764645686337019, 51.837078950425749, 39.674052874857317, 31.12202451160648, 18.187965722164215, 14.262078982805594, 14.022052275710879, 10.556833357039892, 8.1203199302143982, 7.4963190518576521, 6.5222248717485671, 6.2395986300716375, 6.0432489010889272, 5.9871973458662548, 4.8608685963292553, 4.8083196070078422, 4.6905355438623779, 4.6701598908186437, 4.4220410244579522, 4.3548876171826896, 4.0225221237895141, 3.4962033852361891, 3.034004942642015, 2.8095055144575882, 2.606919062392139, 2.4769610157729853, 2.4748614161595044, 2.4147149509245018, 2.4024830122885934, 2.389303547862351, 2.3458788521796681, 2.2343786399975549, 2.1897658930315931, 2.1807650606297413, 2.1178283614914628, 2.1163359833807389, 2.0503103955652935, 2.0308560613901703, 2.0195526111106847, 1.9784491332776719, 1.9753174859422862, 1.9620087280785494, 1.9407378934087465, 1.8929425564100333, 1.8392812726304276, 1.8330456111748235, 1.8099125651768677, 1.7531798702878802, 1.7527525627383951, 1.7298986337636566, 1.6696381646657279, 1.5920654610808156, 1.5772402566959531, 1.5769191110684444, 1.5576984784988552, 1.5365930489207049, 1.5313360012843829, 1.528126422829519, 1.5272598758708851, 1.4764776290147341, 1.468350248729072, 1.4557326024560748, 1.4531325413433656, 1.4278989722513815, 1.4211307535927038, 1.384305820810654, 1.3795247863531417, 1.3789997330780386, 1.3745256395492926, 1.3419584723860662, 1.325735701114823, 1.3121958958420581, 1.2940603973182594, 1.2924895630241222, 1.2739950719832298, 1.245883332600807, 1.2274811850815111, 1.1892603359764917, 1.1873978009546313, 1.158981200829313, 1.1412125760377858, 1.125764989639833, 1.108356857423346, 1.089998175563051, 1.0744739798663281, 1.0706878962298072, 1.0686836034838538, 1.0610851289092709, 1.0554833797786942, 1.0346994175618429, 1.0345827089516941, 1.0296129160898255, 1.0287629040106772, 1.0280220345221245, 1.023148645668484, 1.0075665875400919, 1.0056329560842547, 1.0047424339362963, 1.00387651453348, 1.0037189759842673]

[3, 2, 3, 2, 4, 4, 2, 3, 4, 5, 5, 2, 5, 2, 5, 5, 3, 3, 4, 4, 5, 4, 6, 6, 4, 3, 3, 2, 3, 5, 2, 2, 4, 6, 5, 5, 6, 4, 5, 5, 3, 2, 2, 2, 3, 6, 2, 3, 6, 6, 2, 6, 5, 6, 4, 3, 5, 6, 6, 4, 3, 6, 5, 6, 5, 4, 3, 3, 5, 2, 4, 4, 2, 4, 6, 6, 3, 3, 3, 5, 5, 2, 5, 3, 6, 6, 4, 2, 4, 4, 5, 4, 3, 6, 2, 5, 2, 2, 6, 4, 3, 2, 2, 6, 2, 6, 4, 6, 3, 3, 6, 6, 5, 4, 5, 3, 4, 3, 4, 5, 2, 4, 2, 5]

[2, 3, 2, 2, 2, 2, 2, 2, 3, 2, 3, 3, 3, 2, 2, 2, 3, 3, 2, 3, 3, 4, 2, 2, 3, 4, 3, 4, 4, 2, 3, 4, 4, 3, 5, 3, 5, 2, 4, 5, 2, 5, 4, 4, 2, 4, 2, 3, 5, 2, 5, 3, 4, 2, 6, 5, 6, 6, 4, 4, 2, 5, 4, 6, 5, 3, 6, 3, 5, 2, 2, 6, 5, 5, 4, 5, 3, 4, 6, 6, 4, 6, 3, 5, 5, 6, 3, 2, 5, 6, 3, 3, 5, 6, 6, 6, 3, 4, 5, 4, 4, 6, 5, 5, 6, 4, 6, 4, 6, 5, 5, 4, 6, 5, 6, 6, 6, 6]

[5, 5, 6, 4, 5, 4, 6, 4, 4, 5, 6, 6, 4, 5, 4, 6, 5, 4, 6, 5, 5, 6, 4, 5, 6, 6, 6, 6, 5, 3, 4, 5, 5, 6, 3, 6, 6, 6, 2, 6, 6, 3, 6, 4, 4, 3, 3, 3, 5, 6, 6, 5, 4, 5, 2, 6, 5, 6, 6, 5, 4, 2, 5, 4, 5, 5, 3, 6, 3, 4, 2, 3, 5, 4, 5, 4, 4, 2, 3, 5, 3, 5, 3, 4, 4, 3, 2, 3, 4, 2, 2, 4, 4, 3, 5, 4, 6, 2, 2, 3, 4, 3, 3, 2, 3, 3, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2]

此处的最佳参数为[3,2,5]

[3,2,5]	[2,3,5]	[3,2,6]	[2,2,4]	[4,2,5]
2.01563455435	1.69932928799	1.87092911249	2.38740999858	2.09792962123
[4,2,4]	[2,2,6]	[3,2,4]	[4,3,4]	[5,2,5]
3.730045738	1.8623398687	2.10039237887	1.7122688038	1.89852293453

Chart: HS\_800 out-sample assess function

此处需要注意的是，在最佳组合处的收益率高达两万，具体原因还待探索！

结果表明，对于 22015 年的股灾该策略仍需要改进，下一步探索是在参数 n1 上。在 in-sample 的实验中可看出，n1 和 n3 越大，将这个反趋势的比较周期拉的越长，则对于股灾的亏损会更小，但是对于平稳时期的收益就会相对较少，发生的交易次数也显著变少。