Monte Carlo Experiment With Path Dependent Trader Survival Rates

Which Ones Are Preferable, a Cancer Patient's or a Trader's 5-Year Survival Rates?

Nassim Nicholas Taleb
October 2003

Luck

The idea is to look at a trader's (good or bad) 5 year survival rate (there is no need to go beyond, as we will see). It is done by generating random populations of traders under absorbtion/extinction constraints. The path dependence justifies the Monte Carlo in place of closed form experiment. The constraints are:

1) Peak-to-Valley of x% (say 20%) the trader is extinct once exceeded. PTV for a string between t_0 and T is the largest subsequent adverse deviation -Max $\{S_t - \text{Min}\, S_{\tau > t}\}_{t \in [t_0, T]}$

2) one year of losses exceeding a threshold and the business is history

Note that we are not concerned with events inside the observation period Δt (here one month)

We define the edge as the Coefficient of Variation, the "Sharpe", of the strategy. We can generate combinations and get the results in a Gaussian world (there is no need to complicate with fat tails: the results are sufficiently counterintuitive as they are)

We illustrate the sensitivity of survival to the ex ante profile.

Result: Clearly even with an ex ante the coefficient of variation of 1 E[X]/($\sqrt{V[X]}$)=1, standard deviation (also called "Sharpe") the survival of a trader, owing to the path dependence of the selection process, is slim. One needs a lot a luck!

```
<< "Statistics`NormalDistribution`"
<< "Graphics`Graphics`"
<< "Statistics`DataManipulation`"
```

Procedures

■ Genrator of Random Runs (60 increments)

The next program generates deviations for a given μ and σ pairs and retains 2 tables:

YearlyReturns(year,t), 5 columns

Cumulative Peak to Valey(year,t), 5 columns

```
Generate[T_] := For[t = 1, t ≤ T, V[t] =
   Table[Random[NormalDistribution[μ dt, σ √dt]], {i, 1, 60}];
  B[t] = Table[Sum[V[t][[j]], {j, 1, i}], {i, 1, Length[V[t]]}];
  Ry1[t] = B[t][[12]];
  Py1[t] = Table[-B[t][[i]] + Min[Table[B[t][[j]], {j, i + 1, 12}]],
    {i, 1, 11}]; Ry2[t] = B[t][[24]] - B[t][[12]];
  Py2[t] = Table[-B[t][[i]] + Min[Table[B[t][[j]], {j, i + 1, 24}]],
    {i, 1, 23}]; Ry3[t] = B[t][[36]] - B[t][[24]];
  Py3[t] = Table[-B[t][[i]] + Min[Table[B[t][[j]], {j, i + 1, 36}]],
    {i, 1, 35}]; Ry4[t] = B[t][[48]] - B[t][[36]];
  Py4[t] = Table[-B[t][[i]] + Min[Table[B[t][[j]], {j, i + 1, 48}]],
    {i, 1, 47}]; Ry5[t] = B[t][[60]] - B[t][[48]];
  Py5[t] = Table[-B[t][[i]] + Min[Table[B[t][[j]], {j, i + 1, 60}]],
    {i, 1, 59}]; Clear[V, B, P]; t++; YearlyReturns =
   Table[{Ry1[t], Ry2[t], Ry3[t], Ry4[t], Ry5[t]}, {t, 1, T}];
  CumPtv = Table[{Min[Py1[t]], Min[Py2[t]], Min[Py3[t]],
     Min[Py4[t]], Min[Py5[t]]}, {t, 1, T}];]
```

■ Matrix Manipulations Procedure

The yearly returns matrix comes in 5 lines, one per year and as many columns as simulation lines.

```
Procedure := Do[Winningyearsvector =
    Table[RangeCounts[YearlyReturns[[i]], {0}][[2]],
     {i, 1, numberofsimulations}];
  Print["Mean Winning Years ", N[Mean[Winningyearsvector]]]
   Print["Sample Size  ", numberofsimulations]
   Print["Ex Ante C V (aka Sharpe )  ", μ/σ]
   Print["Ex Post Returns  ", TableForm[
     Table[{i, Mean[Transpose[YearlyReturns][[i]]]}, {i, 1, 5}]]]
   Print["Proportion of Profitable Years  ", TableForm[
     N[Table[{i, Count[Winningyearsvector, i]/numberofsimulations}, {i, 1, 5}]]]]
   Print["Unconditional Peak-to-Valley    ", TableForm[
     Table[{i, Mean[Transpose[CumPtv][[i]]]}, {i, 1, 5}]]]
   Print["Peak to Valley after 5 Years  "]
   Print[Histogram[Transpose[CumPtv][[5]]]] Table[
    If[And[YearlyReturns[[i]][[j]] > loss && CumPtv[[i]][[j]] > minptv],
     Surv[i, j] = 1, Surv[i, j] = 0],
    {i, 1, numberofsimulations}, {j, 1, 5}];
  FinalTable = Transpose[Table[Table[∏_{j=1}^{z} Surv[i, j], {z, 1, 5}],
     {i, 1, numberofsimulations}]];
  Print["Ratio of Survivors Under Conditions ",
   TableForm[Table[{i, N[Mean[FinalTable[[i]]]]}, {i, 1, 5}]]]]
```

Running For a Set of Parameters

■ First Experiment, CV (i.e. "Sharpe" is 1) --The Optimistic Scenario

```
μ = .2; σ = .2; dt = 1/12;
(minptv = -.2;);
loss = 0;
numberofsimulations = 1000;
Timing[Generate[numberofsimulations]]
Procedure

{49.201 Second, Null}
```

Mean Winning Years 4.198

Sample Size 1000

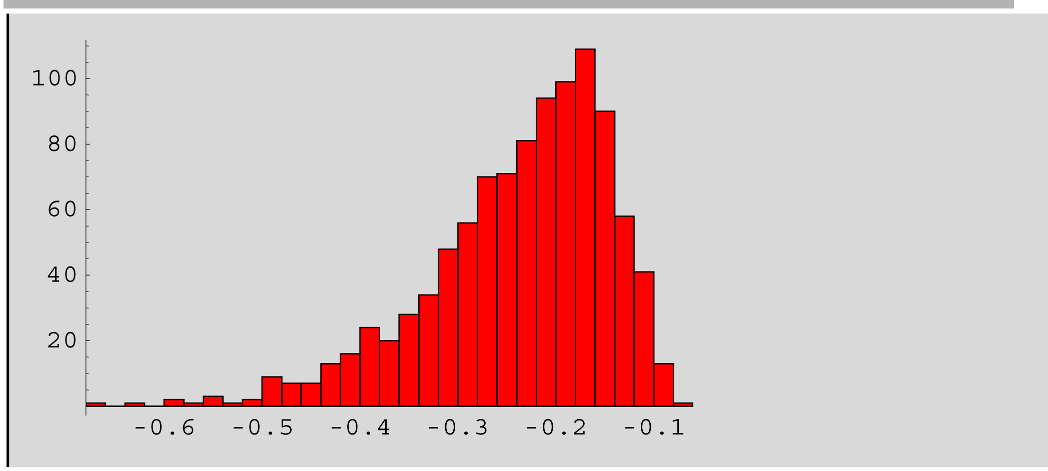
Ex Ante C V (aka Sharpe) 1.

Ex Post Returns	1	0.190711
	2	0.200976
	3	0.190939
	4	0.205615
	5	0.199848

Proportion of Profitable Years	1.	0.
	2.	0.02
	3.	0.157
	4.	0.428
	5.	0.395

Unconditional Peak-to-Valley	1	-0.116353
	2	-0.166157
	3	-0.198919
	4	-0.218636
	5	-0.237238

Peak to Valley after 5 Years



- Graphics -

Ratio of Survivors Under Conditions	1	0.792
	2	0.604
	3	0.451
	4	0.353
	5	0.261

■ Second Experiment, CV (i.e. "Sharpe" is 0) --Does it Make a Difference?

Note that Ptv can become less than -100% (from initial capital) --we are dealing with Gaussian variates.

```
μ = 0; σ = .2; dt = 1 / 12;
minptv = -.2;
loss = 0;
numberofsimulations = 1000;
Generate[numberofsimulations] // Timing
Procedure

{62.14 Second, Null}
```

Mean Winning Years 2.55

Sample Size 1000

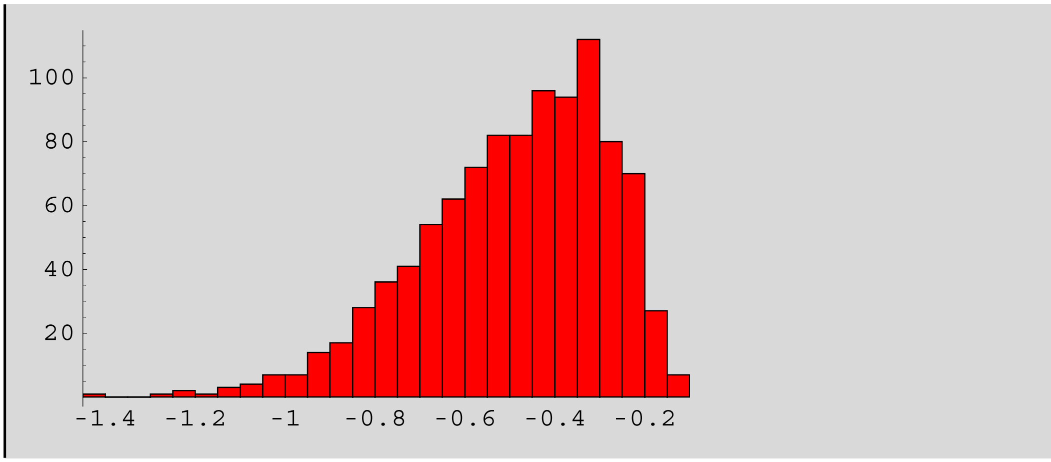
Ex Ante C V (aka Sharpe) 0

Ex Post Returns	1	0.0116368
	2	0.00116335
	3	0.00407746
	4	0.00917769
	5	-0.00368374

Proportion of Profitable Years	1.	0.152
	2.	0.304
	3.	0.304
	4.	0.182
	5.	0.03

Unconditional Peak-to-Valley	1	-0.173141
	2	-0.282292
	3	-0.365246
	4	-0.429513
	5	-0.490305

Peak to Valley after 5 Years



- Graphics -

Ratio of Survivors Under Conditions	1	0.478
	2	0.203
	3	0.074
	4	0.031
	5	0.015

■ Third Experiment, CV (i.e. "Sharpe" is 1) --Tolerated Loss 4% (Generous)

```
μ = .2; σ = .2; dt = 1 / 12;
minptv = -.2;(*minimum peak to valley*);
loss = 0 (*loss threshold for any given year*);
numberofsimulations = 1000;
Generate[numberofsimulations] // Timing
Procedure

{63.542 Second, Null}
```

Mean Winning Years 4.183

Sample Size 1000

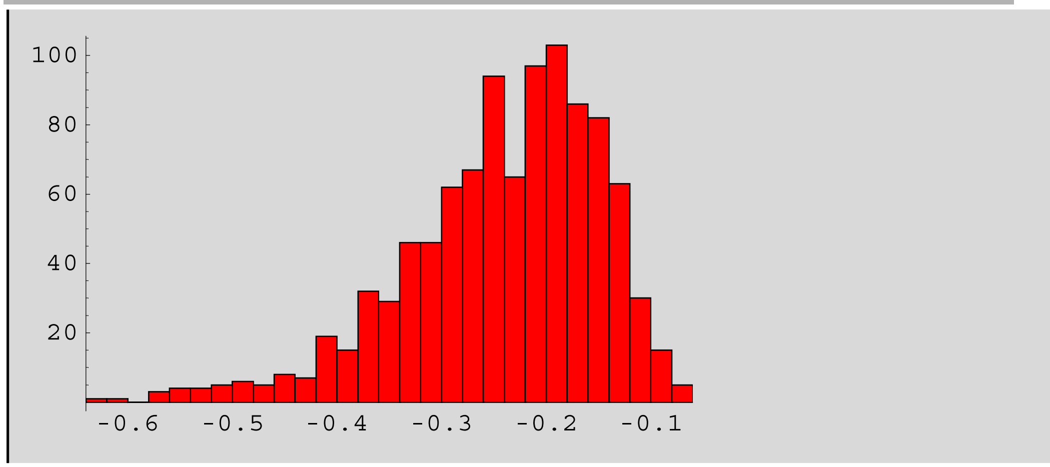
Ex Ante C V (aka Sharpe) 1.

Ex Post Returns	1	0.202086
	2	0.207771
	3	0.193197
	4	0.198674
	5	0.201268

Proportion of Profitable Years	1.	0.
	2.	0.024
	3.	0.153
	4.	0.439
	5.	0.384

Unconditional Peak-to-Valley	1	-0.115885
	2	-0.164524
	3	-0.197358
	4	-0.220853
	5	-0.241323

Peak to Valley after 5 Years



- Graphics -

```
                                      1      0.789
                                      2      0.607
Ratio of Survivors Under Conditions   3      0.448
                                      4      0.346
                                      5      0.263
```

Fourth Experiment, CV (i.e. "Sharpe" is 1/2) --The Most Realistic Case

Note that Ptv can become less than -100% (from initial capital) --we are dealing with Gaussian variates.

```
μ = .1; σ = .2; dt = 1 / 12;
minptv = -.2;
loss = 0;
numberofsimulations = 1000;
Generate[numberofsimulations] // Timing
Procedure

{63.811 Second, Null}
```

```
Mean Winning Years 3.398
```

```
Sample Size  1000
```

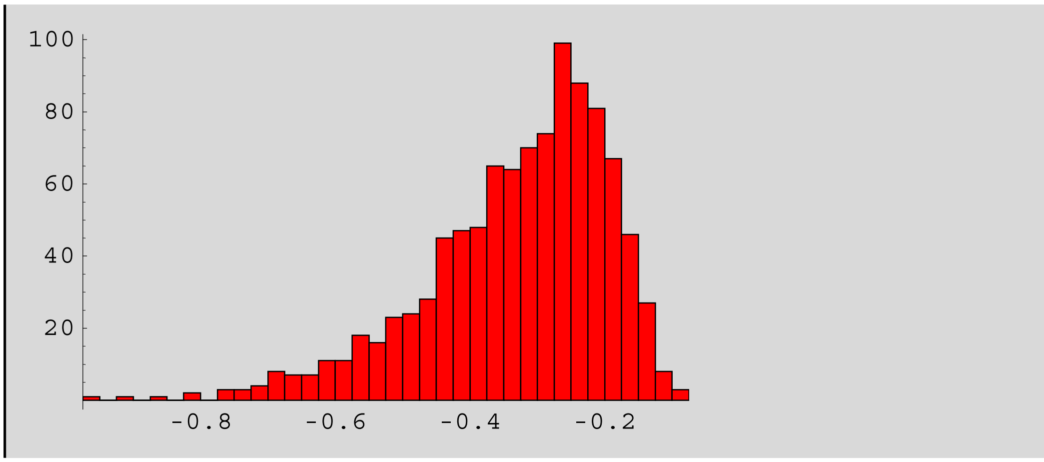
```
Ex Ante C V (aka Sharpe )  0.5
```

```
                  1      0.102471
                  2      0.0992946
Ex Post Returns   3      0.106599
                  4      0.0859277
                  5      0.100093
```

```
                                 1.      0.029
                                 2.      0.148
Proportion of Profitable Years   3.      0.336
                                 4.      0.355
                                 5.      0.129
```

Unconditional Peak-to-Valley	1	-0.139648
	2	-0.208861
	3	-0.257875
	4	-0.299227
	5	-0.329683

Peak to Valley after 5 Years



- Graphics -

Ratio of Survivors Under Conditions	1	0.658
	2	0.393
	3	0.233
	4	0.132
	5	0.076