Business 35150 **John H. Cochrane**

Problem Set 7 answers

Part I answers are included with this week's notes.

Part II:

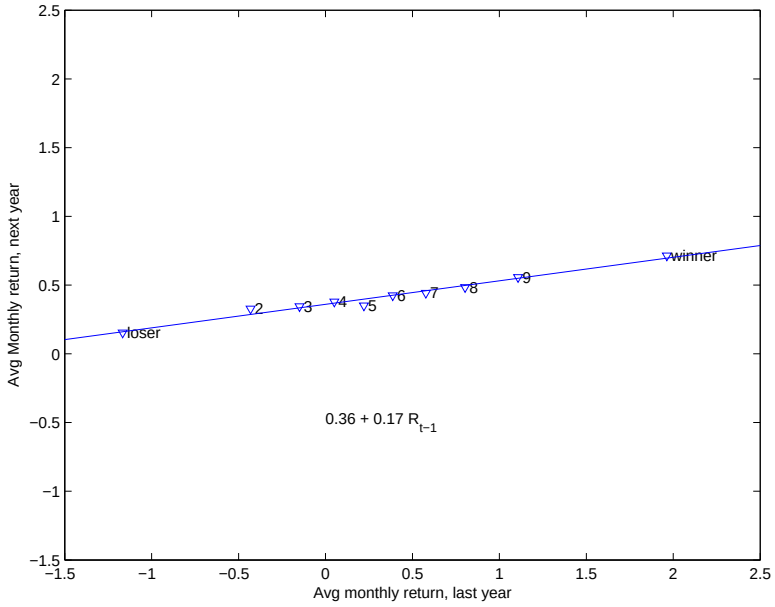
1. The mean xs return is quite similar to Carhart 0.15 to 0.71 compare to 0.01 to 0.68. The CAPM alphas, betas, etc. are also similar.

	loser	2	3	4	5	6	7	8	9	winner	w-l
Mean lag retx	-1.17	-0.43	-0.15	0.05	0.22	0.39	0.58	0.80	1.11	1.96	3.13
Mean xs return	0.15	0.33	0.34	0.38	0.35	0.42	0.44	0.48	0.56	0.71	0.56
std err Mean	0.20	0.19	0.18	0.18	0.18	0.18	0.18	0.19	0.20	0.23	0.15
CAPM alpha	-0.27	-0.09	-0.07	-0.03	-0.06	0.01	0.03	0.06	0.11	0.26	0.53
t(alpha)	-3.25	-1.69	-1.65	-0.72	-2.00	0.20	0.73	1.13	1.63	2.33	3.47
CAPM beta	0.97	0.96	0.95	0.93	0.95	0.96	0.96	0.98	1.02	1.05	0.07
CAPM R2	0.83	0.92	0.95	0.96	0.97	0.97	0.96	0.93	0.88	0.76	0.01
Mean prev return	-1.17	-0.43	-0.15	0.05	0.22	0.39	0.58	0.80	1.11	1.96	3.13
Avg frac > mkt	0.36	0.41	0.42	0.43	0.43	0.46	0.48	0.52	0.54	0.57	
Avg frac < mkt	0.64	0.59	0.58	0.57	0.57	0.54	0.52	0.48	0.46	0.43	

The first row is the mean lag of last year (formation year) returns. The worst funds lost 1.17% per month over the previous year; the best funds gained 1.96% per month in the previous year. I want to give you some sense of how strong the continuation of fund returns is in fact. The the portfolios over the *next* year show the attractive indicated "mean xs return" spread, but that is much less than the spread in their returns *last* year. A very small continuation multiplied by a very large return last year gives the 0.15 - 0.71 percent spread.

I ran a regression on the first two rows of the table and made the graph below. This is a regression with 10 data points, next year's return on the last year's return. The graph shows that the average return next year is almost a perfect linear function of *average return* last year, not portfolio number. That's why the portfolio mean returns have S-shaped patterns – the 1, 10 portfolios have huge values of average return last year. The S shaped portfolio results are hiding an underlying linearity. (You've seen this many times before. A linear function of some characteristic gives a S shaped function of portfolio number since the extreme portfolios are extreme.)

Quantitatively, *the persistence in portfolio returns is the same thing as an acutocorrelation of 0.17 (meaning R^2 of $0.17^2 = 0.029$) in a forecasting regression.* The portfolios correspond to very weak persistence in fund returns! A 10% return this year means a best guess of 1.7% return next year. Similarly, the 1-10 portfolio has a 0.56% return next year and 3.13% return in the previous years, for $0.56/3.13 = 0.18$ regression coefficient.



The frac>mkt and < mkt lines present the risks in a different way – of the funds that were in the top decile last year, how many even beat the market next year? The best answer is 57%. Note also that we don't get half the funds beating the market until we're looking in the 8 or 9 portfolio! Again, I really want to disabuse you of the fallacy that Carhart results mean "funds that went up last year always go up a lot next year."

The four factor model. This looks a lot like Carhart. The alphas are mostly smaller, -0.05% per month rather than -1%. Fama-French umd may be the secret. The losers are still bad with -0.15% per month, but not the huge -0.63% Carhart found – umd does seem to have cleared up that issue. The pattern of betas is the same; not much market beta, u-shaped smb beta with a lot of smb for the winners. Momentum betas are doing the job. R^2 are very high; *portfolios* of funds are very close to indices. Notice we're not rejecting the 4 factor model.

carhart portfolios, 4 factor model

	loser	2	3	4	5	6	7	8	9	winner	w-l
4F alpha	-0.15	-0.05	-0.06	-0.03	-0.08	-0.03	-0.05	-0.06	-0.05	0.01	0.16
t on 4F alpha	-2.00	-1.00	-1.53	-0.76	-2.50	-0.90	-1.47	-1.42	-1.09	0.15	1.36
4F b	0.92	0.94	0.93	0.92	0.93	0.95	0.94	0.95	0.96	0.95	0.03
4F h	0.02	0.02	0.04	0.02	0.02	0.01	0.01	0.01	-0.01	-0.08	-0.10
4F s	0.16	0.10	0.07	0.07	0.08	0.09	0.14	0.22	0.35	0.53	0.37
4F u	-0.20	-0.08	-0.05	-0.03	-0.01	0.02	0.06	0.10	0.15	0.26	0.46
4F R2	0.87	0.93	0.96	0.96	0.97	0.97	0.98	0.96	0.95	0.91	0.44

chi2 GRS statistic, prob value	17.42	6.56	
10, 5, 1% p values of chi2(N)	15.99	18.31	23.21
F GRS statistic, prob value	1.70	7.77	
10, 5, 1% p values of F	1.61	1.85	2.35

2. Here are the results sorting on 5 year returns. Interestingly *there is almost no spread in mean returns! The mean returns* only vary from 0.31 to 0.49. *5 year performance averages just don't see to*

mean much!

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5-0 portfolios, 4 factor model.
              loser       2       3       4       5       6       7       8       9  winner     w-l
         mean  0.31    0.35    0.39    0.40    0.40    0.36    0.43    0.41    0.42    0.48    0.17
     4F alpha -0.14   -0.08   -0.06   -0.04   -0.03   -0.08   -0.04   -0.04   -0.05    0.00    0.14
t on 4F alpha -2.16   -1.97   -1.43   -1.23   -0.84   -2.73   -1.19   -1.10   -1.11    0.01    1.34
         4F b  0.88    0.90    0.93    0.92    0.93    0.94    0.94    0.95    0.97    0.98    0.10
         4F h  0.11    0.08    0.09    0.08    0.04    0.02    0.01   -0.02   -0.06   -0.22   -0.33
         4F s  0.20    0.07    0.07    0.04    0.07    0.09    0.13    0.14    0.22    0.36    0.16
         4F u -0.04   -0.00   -0.00    0.01    0.01    0.01    0.05    0.04    0.05    0.08    0.12
        4F R2  0.90    0.95    0.96    0.97    0.96    0.98    0.97    0.97    0.96    0.93    0.34
chi2 statistic, prob value         13.98   17.37
10, 5, 1% p values of chi2(N)      15.99   18.31   23.21
F statistic, prob value             1.36   19.56
10, 5, 1% p values of F             1.61    1.85    2.36
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3. Alphas

```
alpha t stat 5, 50 95 percenties
   -2.7748   -0.5274    1.7544

 N 5, 50, 95,
   -1.6449         0    1.6449

 t 5, 95, 24 degrees of freedom
   -1.7109         0    1.7109

 alpha 5, 50 95
   -0.6098   -0.0749    0.3398
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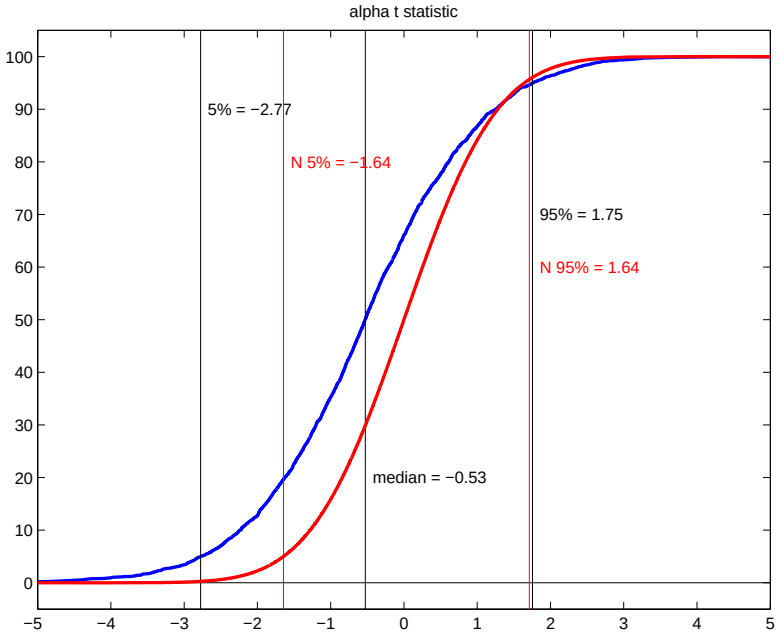
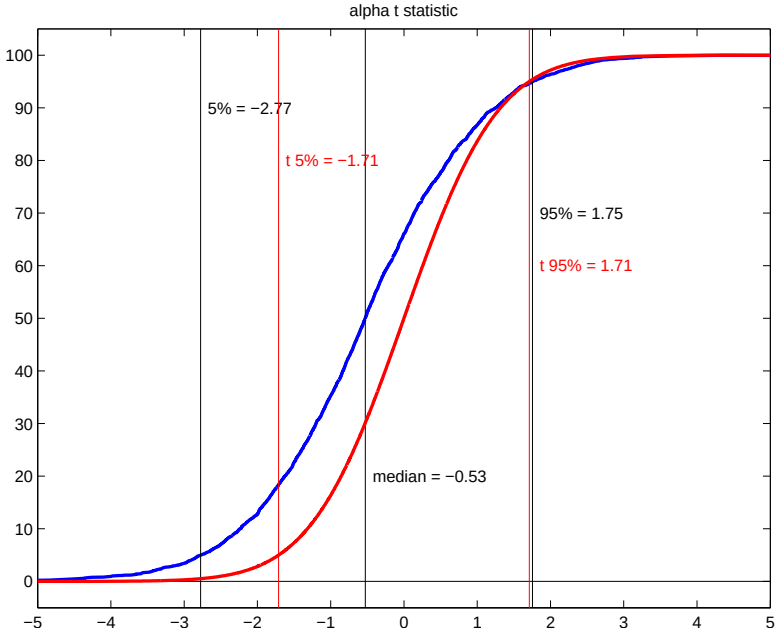
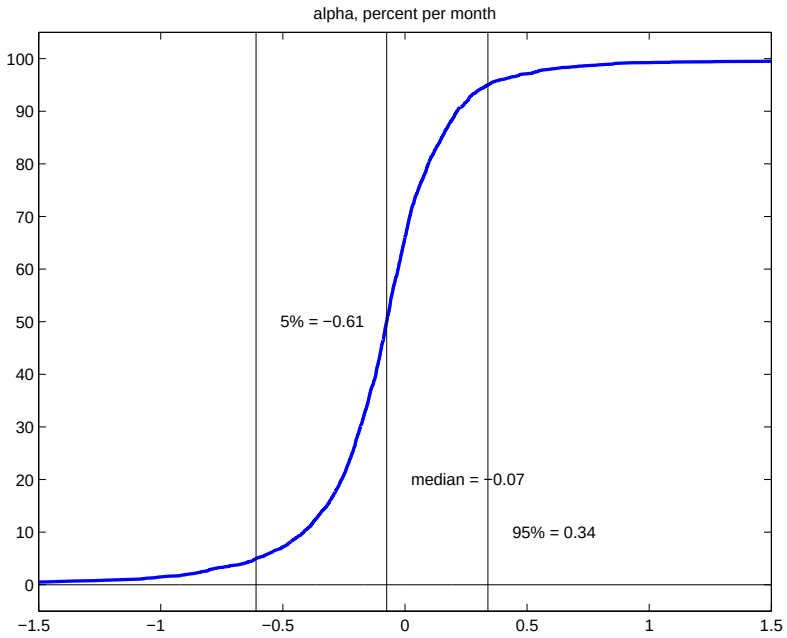
These look just like Fama and French. The median alpha t stat is -0.53; The lower 5% tail happens at -2.77. The upper tail happens at 1.75. We don't have the bootstrap distribution, but we can compare to a normal (first row above, figure below) or a t distribution (second row, figure). The problem with the t distribution is that the different funds last different amounts of time, so they have different degrees of freedom. I used 24 degrees of freedom (2 years) as a guess in the second figure. As you see, the normal and t distributions really give about the same answer here. The t (24) distributions says the 5% tails should happen at +/- 1.71; the normal distribution says 1.64, not that different. It looks like average skill is slightly negative, but there is some skill as the distribution is a bit spread out and just few more good funds than there should be.


alpha t statistic
5% = −2.77
N 5% = −1.64
95% = 1.75
N 95% = 1.64
median = −0.53


alpha t statistic
5% = −2.77
t 5% = −1.71
95% = 1.75
t 95% = 1.71
median = −0.53



The actual alpha distribution is not as impressively shifted – only 0.07% per month median underperformance. It's also quite wide. The upper and lower 5% values happen at -0.61 and +0.34 bp per month – -7% and +4% per year! Making the transformation to t statistics was really important for reducing the influence of small, short-lived, high volatility funds.