MGMT 237E:
Empirical Methods in Finance

Homework 2

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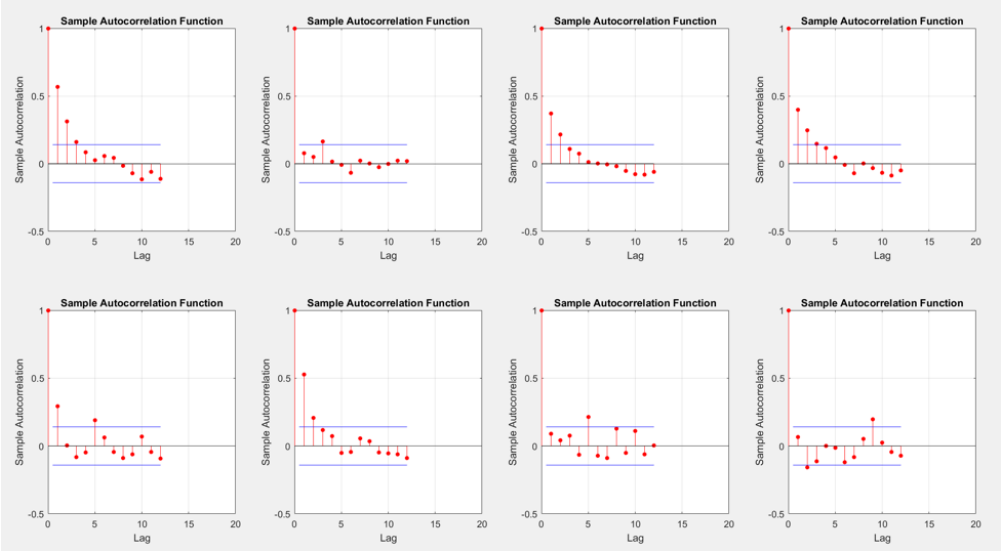
1.1./1.2. Mean Returns and Standard Errors:

	meanReturn	bsMeanSTD
CSTCVAH	0.65525	0.14304
CSTEMNH	0.48604	0.21579
CSTEVDH	0.83064	0.12304
CSTDISH	0.89713	0.133
CSTRARH	0.58782	0.084435
CSTFIAH	0.44069	0.12161
CSTGLMH	1.0255	0.20375
CSTMNFH	0.59361	0.24109

1.3. Auto-correlation Graphs and Table:

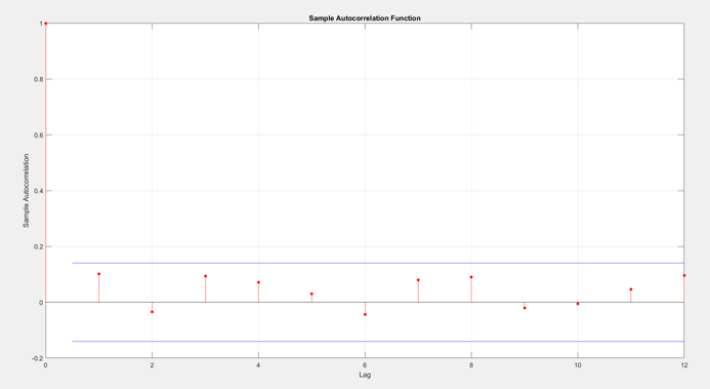


	CSTCVAH	CSTEMNH	CSTEVDH	CSTDISH	CSTRARH	CSTFIAH	CSTGLMH	CSTMNFH
lag 0	1	1	1	1	1	1	1	1
lag 1	0.56793	0.076343	0.37005	0.39825	0.29215	0.5275	0.088374	0.065387
lag 2	0.31038	0.04944	0.21402	0.24714	0.0026865	0.20667	0.041638	-0.15916
lag 3	0.16182	0.16516	0.10733	0.14689	-0.080494	0.11665	0.07613	-0.11341
lag 4	0.08319	0.01699	0.074028	0.11443	-0.047013	0.073187	-0.063298	0.0018591
lag 5	0.026878	-0.009461	0.011066	0.045974	0.18905	-0.049946	0.21389	-0.012311
lag 6	0.055698	-0.068242	0.0019902	-0.010041	0.063076	-0.045618	-0.072735	-0.11996
lag 7	0.042313	0.02122	-0.004199	-0.07135	-0.043859	0.055543	-0.088405	-0.082823
lag 8	-0.017136	0.0017539	-0.019774	0.0012848	-0.087921	0.03498	0.12672	0.053873
lag 9	-0.071125	-0.026432	-0.055079	-0.033402	-0.062772	-0.048933	-0.052742	0.19607
lag 10	-0.11454	-0.0018875	-0.07863	-0.065604	0.069361	-0.055018	0.11228	0.025179
lag 11	-0.060629	0.023698	-0.081339	-0.087282	-0.045527	-0.061661	-0.060691	-0.044488
lag 12	-0.11242	0.01851	-0.061719	-0.048847	-0.093189	-0.090282	0.0054261	-0.071637

1.4. Ljung-Box Test results: (A "false" decision means that there is not enough evidence to reject the null hypothesis of no auto-correlation. A "true" decision means returns are auto-correlated.)

	decision	Pval
CSTCVAH	true	3.3307e-16
CSTEMNH	false	0.71598
CSTEVDH	true	8.8741e-06
CSTDISH	true	7.4117e-08
CSTRARH	true	0.0007078
CSTFIAH	true	3.0879e-11
CSTGLMH	true	0.021401
CSTMNFH	true	0.021873

1.5. CRSP-VW stock market index has no significant auto-correlation with Lag 1. Compared to this benchmark, investment strategies: 1-CSTCVAH, 3-CSTEVDH, 4-CSTDISH, 5-CSTRARH, 6-CSTFIAH have significant auto-correlation with Lag 1, which is indicative of exposure to liquidity risk.



1.6. Nonparametric (i.i.d) bootstrapping will not retain auto-correlation characteristics consistent with the original data set. The "block bootstrap" method should be used to capture auto-correlation features of data. By sampling blocks of data instead of single observations, auto-correlation characteristics of the data can be preserved. The calculation of auto-correlations suggests there is a significant dependency on "Lag 1" values in this data. Because of this, the i.i.d. assumption does not hold and nonparametric (i.i.d) bootstrapping is no longer appropriate. If nonparametric bootstrapping is used, auto-correlation effects will be ignored.

1.7. Summary of block bootstrap standard errors are added in the last column of the table below. A block of size four is used as the auto-correlation predominantly comes from the four most recent lag periods.

	meanReturn	bsMeanSTD	blockbsSTD
CSTCVAH	0.65525	0.1436	0.21397
CSTEMNH	0.48604	0.21234	0.24061
CSTEVDH	0.83064	0.12384	0.1685
CSTDISH	0.89713	0.13608	0.18605
CSTRARH	0.58782	0.084985	0.10117
CSTFIAH	0.44069	0.11996	0.17281
CSTGLMH	1.0255	0.20173	0.22358
CSTMNFH	0.59361	0.23757	0.22433

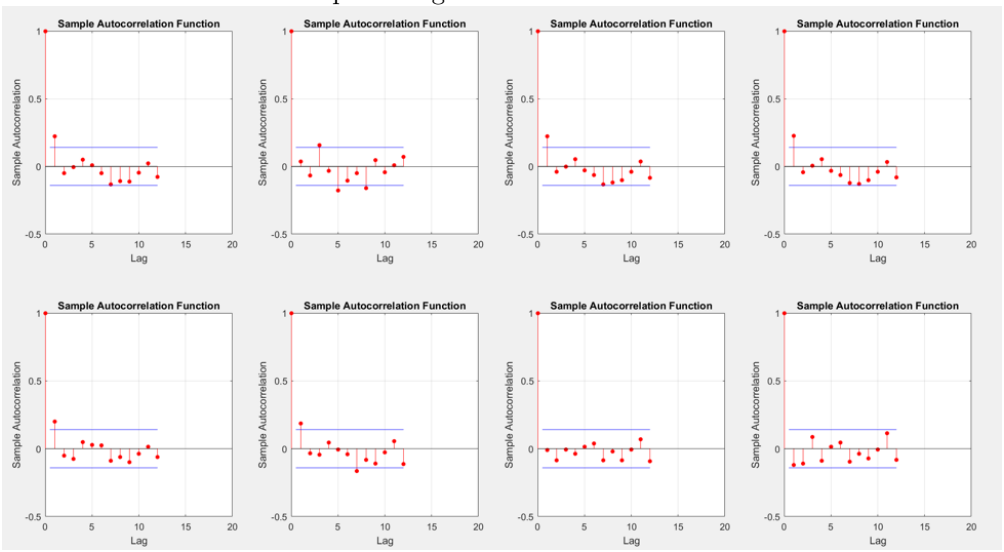
2.1. Linear Clone Betas:

	CSTCVAH	CSTEMNH	CSTEVDH	CSTDISH	CSTRARH	CSTFIAH	CSTGLMH	CSTMNFH
beta_1	-0.0050209	0.043767	0.0042033	0.0078718	0.0063509	-0.0011619	0.014782	0.022922
beta_2	0.47253	0.15305	0.43828	0.44975	0.47552	0.44517	0.54499	0.52987
beta_3	-0.073961	0.09948	-0.017368	-0.03731	0.078411	0.077012	0.1724	0.25336
beta_4	0.54009	0.59313	0.50113	0.51089	0.40061	0.38224	0.18391	0.057526
beta_5	0.066361	0.11057	0.073759	0.068802	0.039107	0.096742	0.083915	0.13632

2.2. Average return of actual returns, linear clones, and 'levered up' linear clones:

meanR	meanR_star	meanR_hat
0.0065525	0.005883	0.0098727
0.0048604	0.0058469	0.012549
0.0083064	0.0058178	0.0092639
0.0089713	0.0059765	0.010344
0.0058782	0.0054108	0.0080585
0.0044069	0.0054138	0.0093096
0.010255	0.0054746	0.018278
0.0059361	0.0054769	0.016559

2.3. Auto-correlation up to "Lag 12" for the cloned returns of $\hat{R}$:



	CSTCVAH	CSTEMNH	CSTEVDH	CSTDISH	CSTRARH	CSTFIAH	CSTGLMH	CSTMNFH
lag 0	1	1	1	1	1	1	1	1
lag 1	0.22199	0.036444	0.22337	0.22499	0.1987	0.18474	-0.01072	-0.11924
lag 2	-0.049609	-0.066322	-0.039448	-0.043973	-0.050375	-0.034281	-0.086286	-0.10916
lag 3	-0.0047881	0.15537	-0.0010893	0.0038969	-0.073531	-0.042497	-0.0079205	0.08829
lag 4	0.051611	-0.03443	0.052569	0.052734	0.048155	0.045191	-0.037168	-0.089306
lag 5	0.0089959	-0.17782	-0.028225	-0.033513	0.028718	-0.0051435	0.012975	0.015832
lag 6	-0.049815	-0.10429	-0.062835	-0.062273	0.023841	-0.04014	0.038012	0.045414
lag 7	-0.13201	-0.048938	-0.13303	-0.12292	-0.090069	-0.16406	-0.084728	-0.094928
lag 8	-0.10833	-0.1617	-0.11777	-0.12864	-0.061426	-0.081299	-0.019775	-0.036027
lag 9	-0.11046	0.045168	-0.10329	-0.10207	-0.098009	-0.10958	-0.08385	-0.071413
lag 10	-0.045735	-0.043315	-0.039323	-0.038579	-0.036051	-0.026182	-0.0072527	-0.0068467
lag 11	0.020996	0.0073373	0.034701	0.033537	0.014199	0.055677	0.069711	0.11274
lag 12	-0.07917	0.069479	-0.085078	-0.080113	-0.062068	-0.11209	-0.093873	-0.083306

There seems to be less significant auto-correlation than the actual hedge fund returns for almost all the funds except fund 2-CSTEMNH.

2.4. Ljung-Box test results for the cloned returns $\hat{R}$ auto-correlation up to "Lag 12":

	decision_hat	Pval_hat
CSTCVAH	true	0.033356
CSTEMNH	true	0.025431
CSTEVDH	true	0.025703
CSTDISH	true	0.025319
CSTRARH	false	0.18065
CSTFIAH	true	0.042514
CSTGLMH	false	0.76375
CSTMNFH	false	0.16298

Auto-correlation is not significant for 5-CSTRARH, 7-CSTGLMH, and 8-CSTMNFH.

2.5. A significant auto-correlation with short lags indicates exposure to liquidity risk. The cloned strategies are replicated by returns on liquid instruments, which have little exposure to liquidity risk. Because the auto-correlation of cloned strategies for "Lag 1" is much lower than that for actual hedge fund return, the liquidity risk seems to have been displaced.

ACF(1) for cloned strategy:
0.2220 0.0364 0.2234 0.2250 0.1987 0.1847 -0.0107 -0.1192

ACF(1) for hedge funds:
0.5679 0.0763 0.3700 0.3982 0.2922 0.5275 0.0884 0.0654

We can say to some extent the liquidity risk is reduced in cloned portfolio, but there are other inherent risks related to the underlying instruments. Therefore it is possible that the liquidity risk took on different form in the cloned portfolios which are less prone to liquidity risks.

Also we see the cloned return is lower than hedge fund returns (refer to result in question 2.2). This may be partially caused by the liquidity premium in the hedge fund returns, and high leverages that hedge fund utilizes. Comparing the actual funds' performance with those of 'levered up' cloned portfolio, the risks taken are similar but mean returns for the 'levered up' cloned portfolio are higher. Liquidity risk can be reduced by cloned portfolios.