Final Exam

Spring 2018

- This is a 24-hour from 6pm June 14th, 2018, to 6pm June 15th, 2018.
- Late submission rules: The deadline is 6pm June 15th, 2018. No points will be subtracted from the final grade if you submit your exam until 6:14:59pm, i.e., 6:14pm and 59 seconds. However, your grade will be reduced by 30% if you submit after 6:14:59pm.
- No submission will be accepted after 6:29:59pm.
- Please write your full name.

By submitting your final 24-hour take-home exam, you agree to the following:

As a member of the UCLA Anderson community, I am guided in my daily actions and decisions by the principles of Honesty, Integrity, Mutual Respect, Personal Responsibility, and Professionalism.

I recognize that the integrity of the entire Anderson community—and the dignity afforded to me by my association therewith—rests with the honorable actions of every individual, both on-campus and in the community. To this end, I pledge to affirmatively uphold, in both word and deed, these principles in my dealings with all members of the UCLA Anderson community students, faculty, administration, staff, and alumni.

I acknowledge my obligations under the UCLA Anderson Honor Code and pledge to follow the ethical standards for exam taking it implies. Specifically, I pledge that I shall use only the allowed resources in taking this exam and shall neither give nor receive any type of forbidden aid.

Final Exam

This is an **individual assignment**, and you **cannot** discuss it with your classmates. We will check similarities between submissions, and, if any two submissions are too similar, then both submissions will not be considered for grading.

Please submit your code (R or Python) as well as a separate write-up. Explain the procedure clearly in the write-up (such that someone unfamiliar with the problem could solve it). Use CCLE to submit your answers. If there is something that is unclear in this assignment or in the paper, you are expected to clearly state and justify any assumptions you may make in the write-up. This is a 24-hour exam, and no changes will be made. Do not contact either the professor or the TA.

The structure of the write-up and code should follow the general guidelines used in the problem sets this quarter. You should submit two files:

- .R **FinalExam_YourStudentID** (for example, FinalExam_012345678.R), with **all** code used in answering the questions written below. Python codes are also accepted. If you have multiple files with different codes, submit a zip file with all the code used.
- .pdf **FinalExam_YourStudentID** (for example, FinalExam_012345678.pdf), with discussion on how you answered the questions written below, as well as responses to any particular questions asked.

In this exam, you will construct portfolios that hedge different risk factors. You will verify that it is possible to construct these portfolios without significant reduction in average returns. These findings are from a recent working paper by Herskovic, Moreira and Muir (2018). Please answer the questions below:

1. (50 points) Replicate Table 1 below. This is an updated version of Table 1 in Herskovic, Moreira, and Muir (2018).[1]

Hints:

- The key difference between Table 1 and the original table is the time sample used. Table 1 is based on portfolio returns from December 1925 to December 2017. The table in the paper uses a sample up until December 2016.
- Read Sections 1 and 2.1 in the paper. Section 1 explains the procedure for both daily and monthly data, but you will only need the monthly data procedure (macro series). Section 2.1 provide more details about Table 1.
- Use CRSP monthly returns data (not daily).
- Use shares codes 10, 11, and 12.
- The portfolio sorting is based on all stocks in the three major exchanges (Amex, NYSE, and Nasdaq).
- Apply a penny stock filter by removing all stocks with price lower than $1.00.

[1] Herskovic, Moreira, Muir. Hedging Risk Factors, SSRN Working Paper, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3148693

- When forming the hedge portfolios (Panel A), stocks are sorted into deciles, and the hedge portfolio is a portfolio that goes long the lowest-beta decile and short the highest-beta portfolio.
- In Panel B, the 'Market Plus Hedge' (macro-hedged portfolio) is the market portfolio plus the hedge portfolio from Panel A.
- Pay attention to how to lag variables. This is a bit different from the problem sets. See last paragraph of page 6/top of page 7 in the paper.
- The data are available from different sources:
  - Use stock returns data from CRSP.
  - Use the Market portfolio of equity and the risk-free rate from Ken French website.
  - The industrial production, initial claims, slope of the term structure and credit variables are from Fred. However, all these data are compiled in one excel file, *MFE_FinalExam_data.xlsx*:
    - The sheet *macroseries* contains the following macro series from Fred: Industrial Production Index, Moody's Seasoned Aaa Corporate Bond Yield, Moody's Seasoned Baa Corporate Bond Yield, 5-Year Treasury Constant Maturity Rate (GS5), Initial Claims, 3-Month Treasury Bill (TB3MS).
    - The credit spread is simply the difference between AAA and BAA.
    - The slope of the term structure is the difference between GS5 and TB3MS.
    - When computing stock exposure to macro series, use log change in industrial production, negative log change in initial claims, negative change in credit spread, and change in the slope of the term structure.
  - Panel C reports the full sample exposure (beta) and t-statistics of the Market plus hedge portfolios with respect to different macro risk factors.
  - In Panel C, the macro-hedged portfolios (market plus hedge) are at monthly frequency, but some of the macro series are at quarterly or annual frequency. Compound the macro-hedged portfolios' return at quarterly or annual frequency according to the frequency of each regression. Compound returns from monthly to quarterly series as follows:
    (i) Add the risk free rate of return to the monthly returns— now portfolio weights sum to one.
    (ii) Add 1 to the returns, so that 2% return plus risk-free rate in a given month will be represented as 1.02.
    (iii) Compute the product of the monthly return plus risk-free rate from item (ii) within each quarter and then subtract 1 (e.g. $1.02 \times 0.98 \times 1.05 - 1$). At this point you will have a quarterly series of returns plus risk-free rate.
    (iv) Now construct the quarterly risk-free rate of return. Add 1 to the risk free rate, compute the product with each quarter and then subtract one. For example, if the monthly risk free rates in a quarter were 0.5%, 0.2%, and 0.01%, then the compounded risk-free rate in that quarter will be: $1.005 \times 1.002 \times 1.0001 - 1$.
    (v) Finally, subtract the quarterly risk-free rate from the quarterly portfolio returns, i.e. the quarterly portfolio excess returns will be the quarterly series from item (iii) minus the quarterly series from item (iv).

    Follow a similar procedure to construct annual returns.
  - In Panel C, you will compute the exposures of the macro-hedged portfolios (market plus hedge) with respect to the different macro factors. These factors are in the file *MFE_FinalExam_data.xlsx* as well:

- The sheet *NBER* contains the NBER recession dummies at monthly frequency. This is the variable "Recession".
- The sheet *FRED* contains real personal consumption expenditures per capita and real gross domestic product per capita. These data are at quarterly frequency. These data are in level, and you will need to compute log changes. You will use these series to construct the variables "1-quarter Δc", "1-year Δc", "1-quarter Δgdp", and "1-year Δgdp".
- The sheet *Yogo* contains real consumption growth rates of durables (GrowthDur) and non durables (GrowthNondur). These data are at quarterly frequency and are in log changes (growth rates). These are the variables "1-quarter Δc_{dur}" and "1-quarter Δc_{nondur}"
- The sheet *labor* contains labor income growth (l) in column H. These data are at monthly frequency. This is the variable "1-month Δl".
- The sheet *stockholderconsumption* contains Stockholder consumption growth, 12-quarter growth rate (C_{s12}), Stockholder consumption growth, 24-quarter growth rate (C_{s24}), Top stockholder consumption growth, 12-quarter growth rate (C_{stop12}), and Top stockholder consumption growth, 24-quarter growth rate (C_{stop24}). These data are at monthly frequency and are in growth rates. These are the variables "1-month Δc_{s12}", "1-month Δc_{s24}", "1-month Δc_{stop12}", and "1-month Δc_{stop24}".
- The sheet *Consumption* contains Paker-Julliard (pj), fourth to fourth quarter (q4), and unfiltered (unfil) consumption growth data. These data are at annual frequency. These are the variables "1-year Δc_{pj}", "1-year Δc_{q4}", and "1-year Δc_{unfil}".

2. (15 points) The paper does not use breakpoints based on NYSE stocks. Explain why this could be an issue. Show that these results are robust to using NYSE breakpoints, by replicating Table 2 below. Table 2 reports the same set of results but using NYSE breakpoints when forming the hedged portfolios.

3. (15 points) The results from the previous two items suggest that one can construct these macro-hedged portfolios without significantly lowering average returns. What is the industry composition in the long and short legs of these portfolios? How can you further characterize these portfolios?

Hints:

- You can use two-digit Standard Industry Classification (SIC) or two-digit North American Industry Classification System (NAICS) codes to describe these portfolios.
- SIC and NAICS codes are available in CRSP monthly.

4. (20 points) Data mining is a significant concern in empirical asset pricing. As discussed in class, one approach to address this problem is to conduct extensive robustness exercises and other empirical analyses. Discuss additional robustness exercises that would help to verify whether these findings are driven by data mining.

Hints:

- No need to code the robustness exercises.
- Explain in detail the exercises you suggest and justify.

Table 1: **Macro Hedged Portfolios**

Panel A: Hedge Portfolios

	Mkt.	Industrial Production			Initial Claims			Credit	Slope
		1 mth.	3 mth.	6 mth.	1 mth.	3 mth.	6 mth.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Avg. Return	–	1.32	−2.60	−1.06	3.16	−0.04	1.57	0.80	0.68
t-stat.	–	0.69	−1.16	−0.47	1.30	−0.01	0.55	0.36	0.34
Volatility	–	17.91	20.78	21.07	16.45	20.64	19.27	20.35	15.54
Sharpe ratio	–	0.07	−0.13	−0.05	0.19	−0.00	0.08	0.04	0.04
Post-formation β	–	−4.05	−5.39	−2.23	−1.17	−1.59	−0.64	−1.17	−0.15
t-stat.	–	−3.73	−10.38	−6.21	−2.29	−4.43	−2.81	−8.60	−2.39

Panel B: Market Plus Hedge

	Mkt.	Industrial Production			Initial Claims			Credit	Slope
		1 mth.	3 mth.	6 mth.	1 mth.	3 mth.	6 mth.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Avg. Return	7.96	9.62	6.05	7.78	9.82	6.63	8.31	9.10	7.42
t-stat.	4.11	4.28	2.97	3.79	3.71	2.34	3.02	4.76	2.92
Volatility	18.51	20.88	18.93	19.03	17.92	19.15	18.56	17.77	19.61
Sharpe ratio	0.43	0.46	0.32	0.41	0.55	0.35	0.45	0.51	0.38
Post-formation β	–	0.43	−1.15	−0.25	−0.14	0.01	0.49	−0.07	−0.12
t-stat.	–	0.33	−2.32	−0.76	−0.25	0.02	2.21	−0.54	−1.48
Market Exposure	–	5.05	4.63	2.21	1.19	1.43	1.09	1.13	0.05
t-stat.	–	4.66	10.50	7.63	2.66	5.76	6.46	9.39	0.87

Panel C: Macro Risk of Market Plus Hedge

	Mkt.	Industrial Production			Initial Claims			Credit	Slope
		1 mth.	3 mth.	6 mth.	1 mth.	3 mth.	6 mth.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Recession	−29.71	−21.40	−20.06	−17.01	−21.62	−15.03	−16.76	−12.32	−15.73
t-stat.	−6.00	−3.45	−3.56	−2.97	−2.77	−1.79	−2.06	−2.33	−2.08
1-quarter Δc	1.22	0.96	0.06	−0.28	0.79	−0.54	−1.28	−0.09	−0.69
t-stat.	2.06	1.19	0.07	−0.34	0.74	−0.45	−1.16	−0.13	−0.66
1-year Δc	1.05	0.94	0.79	0.64	1.18	0.47	0.37	0.74	0.40
t-stat.	3.98	3.14	2.02	1.94	2.41	0.79	0.79	2.40	1.12
1-quarter Δgdp	0.89	0.61	−0.39	−0.05	1.67	0.15	−0.05	−0.14	0.14
t-stat.	1.73	0.87	−0.60	−0.07	1.91	0.16	−0.06	−0.25	0.16
1-year Δgdp	1.04	0.76	0.61	0.76	0.98	0.42	0.68	0.45	0.63
t-stat.	5.36	3.44	2.01	3.00	2.03	0.88	1.51	1.73	1.79
1-quarter Δc_{dur}	−1.73	−1.92	−2.16	−0.99	−0.20	0.33	1.54	−0.24	−2.56
t-stat.	−1.60	−1.32	−1.57	−0.63	−0.11	0.17	0.83	−0.19	−1.63
1-quarter Δc_{nondur}	4.29	2.83	3.76	2.88	4.82	3.42	4.70	2.29	2.98
t-stat.	4.17	1.99	2.80	1.88	2.61	1.77	2.43	1.87	1.83
1-month Δl	0.90	0.81	0.88	0.19	0.37	0.13	−0.39	0.10	0.39
t-stat.	2.10	1.33	1.57	0.34	0.67	0.22	−0.68	0.20	0.70
1-month Δc_{s12}	0.00	−0.01	0.00	−0.00	0.01	0.04	−0.01	0.02	−0.02
t-stat.	0.05	−0.26	0.01	−0.05	0.17	0.83	−0.30	0.53	−0.43
1-month Δc_{s24}	0.02	0.04	0.02	−0.02	0.03	0.03	−0.02	0.04	0.01
t-stat.	0.60	0.95	0.40	−0.47	0.89	1.00	−0.74	1.26	0.20
1-month Δc_{stop12}	−0.01	0.00	0.01	−0.01	0.00	0.02	0.01	−0.00	0.01
t-stat.	−0.44	0.17	0.25	−0.28	0.06	1.16	0.50	−0.20	0.24
1-month Δc_{stop24}	−0.01	−0.00	0.00	−0.03	0.00	0.01	−0.01	−0.00	−0.01
t-stat.	−0.58	−0.04	0.08	−1.27	0.05	0.32	−0.65	−0.12	−0.66
1-year Δc_{pj}	1.64	0.84	1.12	1.07	2.44	0.63	0.16	0.30	−0.32
t-stat.	3.89	1.21	1.74	1.37	2.07	0.55	0.14	0.54	−0.32
1-year Δc_{q4}	3.82	3.39	2.95	2.04	6.43	3.62	2.36	3.11	1.65
t-stat.	2.56	1.73	1.48	0.83	2.47	1.43	0.92	1.83	0.75
1-year Δc_{unfil}	1.16	0.88	1.04	0.84	2.64	1.58	0.41	0.52	0.54
t-stat.	2.15	1.21	1.54	1.02	1.84	1.16	0.30	0.90	0.44

Table 2: **Macro Hedged Portfolios using NYSE breakpoints**

Panel A: Hedge Portfolios

	Mkt.	Industrial Production			Initial Claims			Credit	Slope
		1 mth.	3 mth.	6 mth.	1 mth.	3 mth.	6 mth.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Avg. Return	–	1.28	−2.88	−0.85	1.18	0.67	0.12	0.88	0.27
t-stat.	–	0.72	−1.34	−0.39	0.53	0.23	0.05	0.42	0.15
Volatility	–	16.66	19.97	20.02	15.12	19.45	18.10	19.49	14.18
Sharpe ratio	–	0.08	−0.14	−0.04	0.08	0.03	0.01	0.05	0.02
Post-formation β	–	−4.18	−5.36	−2.29	−1.10	−1.57	−0.50	−1.14	−0.15
t-stat.	–	−4.15	−10.80	−6.75	−2.34	−4.65	−2.32	−8.82	−2.65

Panel B: Market Plus Hedge

	Mkt.	Industrial Production			Initial Claims			Credit	Slope
		1 mth.	3 mth.	6 mth.	1 mth.	3 mth.	6 mth.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Avg. Return	7.96	9.58	5.77	8.00	7.84	7.33	6.86	9.18	7.01
t-stat.	4.11	4.42	2.95	4.18	3.22	2.77	2.56	4.96	2.83
Volatility	18.51	20.15	18.17	17.76	16.49	17.85	18.08	17.20	19.15
Sharpe ratio	0.43	0.48	0.32	0.45	0.48	0.41	0.38	0.53	0.37
Post-formation β	–	0.29	−1.13	−0.32	−0.07	0.03	0.63	−0.04	−0.12
t-stat.	–	0.24	−2.37	−1.03	−0.14	0.08	2.94	−0.36	−1.53
Market Exposure	–	5.05	4.63	2.21	1.19	1.43	1.09	1.13	0.05
t-stat.	–	4.66	10.50	7.63	2.66	5.76	6.46	9.39	0.87

Panel C: Macro Risk of Market Plus Hedge

	Mkt.	Industrial Production			Initial Claims			Credit	Slope
		1 mth.	3 mth.	6 mth.	1 mth.	3 mth.	6 mth.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Recession	−29.71	−20.78	−19.63	−13.76	−24.35	−18.11	−21.29	−12.26	−20.27
t-stat.	−6.00	−3.48	−3.63	−2.57	−3.40	−2.32	−2.70	−2.40	−2.75
1-quarter Δc	1.22	1.08	0.22	−0.39	1.00	−0.04	−0.71	0.03	0.03
t-stat.	2.06	1.34	0.30	−0.52	0.99	−0.04	−0.64	0.04	0.03
1-year Δc	1.05	1.01	0.74	0.57	1.09	0.63	0.60	0.72	0.62
t-stat.	3.98	3.34	2.19	1.98	2.66	1.09	1.31	2.72	1.78
1-quarter Δgdp	0.89	0.57	−0.29	−0.28	1.03	0.21	0.11	−0.31	0.52
t-stat.	1.73	0.82	−0.46	−0.43	1.25	0.23	0.13	−0.55	0.64
1-year Δgdp	1.04	0.80	0.55	0.67	0.92	0.46	0.82	0.43	0.81
t-stat.	5.36	3.68	2.10	2.86	2.17	0.91	1.99	1.97	2.29
1-quarter Δc_{dur}	−1.73	−2.14	−1.30	−1.43	−0.97	0.77	0.47	0.29	−2.32
t-stat.	−1.60	−1.50	−0.99	−1.02	−0.57	0.44	0.24	0.24	−1.51
1-quarter Δc_{nondur}	4.29	3.02	3.63	2.73	5.69	3.89	5.06	2.46	3.78
t-stat.	4.17	2.15	2.85	1.98	3.32	2.17	2.55	2.04	2.39
1-month Δl	0.90	1.19	0.68	0.12	0.21	0.10	−0.01	0.06	0.41
t-stat.	2.10	2.07	1.30	0.23	0.42	0.17	−0.03	0.12	0.74
1-month Δc_{s12}	0.00	0.00	0.01	0.00	0.02	0.03	0.01	0.02	−0.01
t-stat.	0.05	0.01	0.24	0.05	0.43	0.76	0.36	0.66	−0.18
1-month Δc_{s24}	0.02	0.05	0.03	−0.00	0.04	0.04	−0.01	0.05	0.01
t-stat.	0.60	1.31	0.74	−0.06	1.33	1.28	−0.21	1.58	0.34
1-month Δc_{stop12}	−0.01	−0.00	0.01	0.00	0.01	0.02	0.02	0.00	0.01
t-stat.	−0.44	−0.05	0.44	0.16	0.34	1.05	0.92	0.10	0.25
1-month Δc_{stop24}	−0.01	0.00	0.00	−0.01	0.01	0.01	−0.01	−0.00	−0.01
t-stat.	−0.58	0.16	0.18	−0.53	0.57	0.57	−0.44	−0.01	−0.61
1-year Δc_{pj}	1.64	0.86	1.11	0.76	1.89	0.96	0.63	0.26	−0.08
t-stat.	3.89	1.23	1.91	1.04	1.82	0.87	0.52	0.46	−0.08
1-year Δc_{q4}	3.82	3.48	3.03	0.45	5.46	4.62	3.02	3.53	2.46
t-stat.	2.56	1.76	1.72	0.20	2.42	1.93	1.11	2.03	1.19
1-year Δc_{unfil}	1.16	0.83	1.08	0.48	2.14	1.95	0.84	0.56	0.84
t-stat.	2.15	1.13	1.77	0.63	1.71	1.49	0.57	0.95	0.72