

Computer Assignment 1

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1. Executive summary

The following data are found in <https://fred.stlouisfed.org/series/DFF> for the short term rate. I found the rest of the data on WRDS. CRSP/Annual Update/Treasuries/CRSP Treasuries - Fixed Term Indexes for the 1-yr and 5-yr term. I used the CRSP/Annual Update/Treasuries/CRSP TREASURIES - Monthly Riskfree Series (1-month and 3-month) for the one month rates. The S & P 500 data is found here CRSP/Annual Update/Index/S&P 500 Indexes/CRSP Index File on the S&P 500. The S & P 500 did include the data.

In this assignment, we calculate the arithmetic and geometric averages of the S&P 500 returns. Then benchmark by computing the risk premium, which is the average returns minus the risk free rate. The following values are found on the table below and are annualized because it is easier to think in annualized term. The third column is risk free arithmetic avg abbreviated. The fourth column is the arithmetic Risk premium average and the last column is the geometric risk premium average.

	Arithmetic Avg	Geometric Avg	Rf Arithmetic	Arith Risk Prem	Geom Risk Prem
Daily	0.1103916	0.1007568	0.0520907	0.0583008	0.0567225
Monthly	0.1079305	0.1007568	0.0449673	0.0629632	0.0525422
Yearly	0.1156076	0.1007568	0.0504899	0.0651177	0.0496034
5-year	0.1476983	0.1042330	0.0527453	0.0949531	0.0618847

You can see that the values do not necessarily increase in a longer time horizon. In addition, we see that the risk premium is roughly half of the S&P500 return, which means doesn't have a too big of a risk premium. Thus, the self-financing strategies have performed positively. Yes, overlapping the longer-term series does lead to different inferences because you would be compounding more and it would provide less standard deviation of returns. If the compounded rate is higher than the short-term series than you should strategize on a more frequent replicating portfolio. It also seems the arithmetic risk premium is bigger than the geometric risk premium.

2. Homework HW1 (indexes) Learn WRDS! Indexes: For the (CRSP) S&P500 with dividends, what was the average arithmetic and geometric historical mean rate of return for daily returns, for monthly returns, for annual returns, and for 5-year returns from 1/1/1973 through 12/31/2018? Do the same for excess rates of return above the prevailing short rate, the 30-day Treasury rate, the 1-year Treasury rate, and the 5-year Treasury rates, respectively. This answers the questions of "how would each of these four self-financed strategies have performed?" (Does overlapping the longer-term series lead to different inference?) Optional: How did HML, SMB, XMKT, etc. do in the last 5 / 10 / 20 / 50 years? What was the worst month?

3. Figures There were only one figure. The results

	Arithmetic Avg	Geometric Avg	Rf Arithmetic	Arith Risk Prem	Geom Risk Prem
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4. Codes The following below was the code to generate this output. Note this is commented.

```
library(readxl)
sp500 <- read.csv("sp500.csv")
names(sp500)[1] <- "Date"
sp500 <- transform(sp500, Date = as.Date(as.character(Date), "%Y%m%d"))
sp500$Date <- as.Date(sp500$Date)
```

```

isYR <- function(data, yr) {
  if(yr == 1) {
    which(data == 2000003)
  } else if (yr == 5){
    which(data == 2000005)
  }
}

feds_1m <- read.csv("fed_1m.csv")[,-1]
feds_yr <- read.csv("feds_yr5.csv")
feds_ffo <- read.csv("DFF.csv")
feds_1yr <- feds_yr[isYR(feds_yr$KYTREASNOX,1), -1]
feds_5yr <- feds_yr[isYR(feds_yr$KYTREASNOX,5), -1]
colnames(feds_1yr)[1] <- c("Date")
colnames(feds_5yr) <- c("Date", "5TDYTM")
colnames(feds_ffo)[1] <- c("Date")
colnames(feds_1m)[1] <- "Date"
feds_1yr$date <- as.Date(feds_1yr$date, "%m/%d/%Y")
feds_5yr$date <- as.Date(feds_5yr$date, "%m/%d/%Y")
feds_ffo$date <- as.Date(feds_ffo$date)
feds <- merge(merge(feds_1yr,feds_5yr, by = "Date"), feds_ffo, by = "Date")
feds[,2:length(feds)] <- feds[,2:length(feds)] / 100
feds_1m$TMYTM <- feds_1m$TMYTM / 100

avg_daily <- mean(sp500$vwretd, na.rm = TRUE)
avg_daily_annual <- avg_daily * 252

library(xts)
sp500_xts <- xts(sp500, order.by = sp500$date)
sp_month_end <- endpoints(sp500_xts, on='month')
sp_month_beg <- head(endpoints(sp500_xts, on='month')+1, -1)
month_ret <- double(length(sp_month_beg))
for (i in (1:length(sp_month_beg))){
  month_ret[i] <- prod(sp500$vwretd[sp_month_beg[i] : sp_month_end[i+1]] + 1) - 1
}
avg_monthly <- mean(month_ret,na.rm = TRUE)
avg_monthly_annual <- avg_monthly * 12

sp_annual_end <- endpoints(sp500_xts, on='year')
sp_annual_beg <- head(endpoints(sp500_xts, on='year')+1, -1)
annual_ret <- double(length(sp_annual_beg))
for (i in (1:length(sp_annual_beg))){
  annual_ret[i] <- prod(sp500$vwretd[sp_annual_beg[i] : sp_annual_end[i+1]] + 1) - 1
}
avg_annual <- mean(annual_ret,na.rm = TRUE)

sp_5yr_beg <- seq(1,length(annual_ret)-1,5)
sp_5yr_end <- seq(5,length(annual_ret)-1,5)
sp_5yr_ret <- double(length(sp_5yr_beg))
for (i in (1:length(sp_5yr_beg))){
  sp_5yr_ret[i] <- prod(annual_ret[sp_5yr_beg[i] : sp_5yr_end[i]] + 1) - 1
}
avg_5yr <- mean(sp_5yr_ret,na.rm = TRUE)

```

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avg_5yr_annual <- avg_5yr / 5
avg_days_yr <- mean(diff(sp_annual_end))
geo_daily <- prod(sp500$vwretd + 1)^(1 / length(sp500$vwretd)) - 1
geo_daily_annul <- (geo_daily+1)^avg_days_yr - 1
geo_monthly <- prod(month_ret + 1)^(1 / length(month_ret)) - 1
geo_monthly_annul <- (geo_monthly+1)^12 - 1
geo_annual <- prod(annual_ret + 1)^(1 / length(annual_ret)) - 1
geo_5yr <- prod(sp_5yr_ret + 1)^(1 / length(sp_5yr_ret)) - 1
geo_5yr_annual <- (geo_5yr+1)^(1/5) - 1

results <- data.frame(matrix(ncol = 2, nrow = 4))
colnames(results) <- c("Arithmetic Avg", "Geometric Avg")
rownames(results) <- c("Daily", "Monthly", "Yearly", "5-year")
results$`Arithmetic Avg` <- c(avg_daily_annual, avg_monthly_annual,
                                 avg_annual, avg_5yr_annual)
results$`Geometric Avg` <- c(geo_daily_annul, geo_monthly_annul,
                             geo_annual, geo_5yr_annual)

avg_daily_yield <- mean(feds$DFF, na.rm = TRUE)
avg_monthly_yield <- mean(feds_1m$TMYTM,na.rm = TRUE)

feds_xts <- xts(feds, order.by = feds$date)
feds_annual_beg <- head(endpoints(feds_xts, on='year')+1, -1)
annual_yield <- feds$TDYTM[feds_annual_beg]
avg_annual_yield <- mean(annual_yield)

feds_5yr_beg <- seq(1,length(annual_yield)-1,5)
feds_5yr_yield <- annual_yield[feds_5yr_beg]
feds_5yr_yield <- (feds_5yr_yield+1)^5 - 1
avg_5yr_yield <- mean(feds_5yr_yield,na.rm = TRUE) / 5
results$'Rf Arithmetic' <- c(avg_daily_yield, avg_monthly_yield,
                             avg_annual_yield, avg_5yr_yield)

avg_day_yr_yield <- mean(diff(feds_annual_beg + 1))
feds$DFF <- feds$DFF / avg_day_yr_yield
feds_1m$TMYTM <- feds_1m$TMYTM / 12

merge <- merge(sp500,feds,by = "Date")

rp_geo_daily <- merge$vwretd - merge$DFF
rp_geo_month <- month_ret - feds_1m$TMYTM
rp_geo_annual <- annual_ret - annual_yield
rp_geo_5yr <- sp_5yr_ret - feds_5yr_yield

geo_daily_yield <- prod(rp_geo_daily+1)^(1/length(rp_geo_daily)) - 1
geo_daily_yield_annual <- (geo_daily_yield+1) ^ 365 - 1
geo_monthly_yield <- prod(rp_geo_month+1)^(1/length(rp_geo_month)) - 1
geo_monthly_yield_annual <- (geo_monthly_yield+1) ^ 12 - 1
geo_annual_yield <- prod(rp_geo_annual+1)^(1/length(rp_geo_annual)) - 1
geo_5yr_yield <- prod(rp_geo_5yr+1)^(1/length(rp_geo_5yr)) - 1
geo_5yr_yield_annual <- (geo_5yr_yield+1)^(1/5) - 1

```

```
rp_daily <- avg_daily_annual - avg_daily_yield
rp_month <- avg_monthly_annual - avg_monthly_yield
rp_annual <- avg_annual - avg_annual_yield
rp_5yr <- avg_5yr_annual - avg_5yr_yield

results$'Arith Risk Prem' <- c(rp_daily, rp_month, rp_annual, rp_5yr)
results$'Geom Risk Prem' <- c(geo_daily_yield_annual, geo_month_yield_annual,
                               geo_annual_yield, geo_5yr_yield_annual)
suppressWarnings(suppressMessages(library(kableExtra)))
kable(results)
```