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<tr><td rowspan="4">2</td><td>ComputeReturns_Breakout1.Rmd (L2B1)</td><td>Compute simple daily returns(Rt) using AAPL price data from yahoo finance.
Plot simple daily returns over time
Compute multi-period simple return</td></tr>
<tr><td>ComputeReturns_Breakout2.Rmd (L2B2)</td><td>Adjust simple return for inflation</td></tr>
<tr><td>ComputeReturns_Breakout3.Rmd (L2B3)</td><td>Adjust simple return for currency</td></tr>
<tr><td>ComputeReturns_Breakout4.Rmd (L2B4)</td><td>Compute log returns(rt)
Compare simple return(Rt) vs log returns(rt)
Covert simple and log returns to different frequency</td></tr>
<tr><td rowspan="4">3</td><td>ConstructingPortfolios_Breakout1.Rmd (L3B1)</td><td>Form buy and hold portfolio
Given each asset’s initial position (share)
Given each asset’s initial value weight
Compute the simple return of portfolio
Method 1 - Using portfolio value
Method 2 - Using the asset returns and their (last period’s) value weights
Compare results of method 1 and 2
Compute the continuous return (log return) of portfolio
Method 1 - Using portfolio value
Method 2 - Using the asset returns and their (last period’s) value weights
Compare results of method 1 and 2
Portfolio performance visualization
Plot the portfolio Profit and loss (PnL) over time
Plot the portfolio returns over time</td></tr>
<tr><td>ConstructingPortfolios_Breakout2.Rmd (L3B2)</td><td>Rebalancing portfolio given the optimal weights(ignore transaction cost)
Constantly rebalance, then infer the share counts and buys/sells
Weekly/monthly rebalance, then infer the share counts and buys/sells
Consider transaction costs K when rebalance
subtract a fixed amount (trading cost) from portfolio value and then reallocate what remains
Constantly rebalance, then infer the share counts and buys/sells
Weekly/monthly rebalance, then infer the share counts and buys/sells</td></tr>
<tr><td>ConstructingPortfolios_Breakout3.Rmd (L3B3)</td><td>Form long and short portfolio(without rebalance)
Equity position
Long position value overtime
Short position value overtime
Short position value overtime:
Portfolio equity value overtime</td></tr>
<tr><td>ConstructingPortfolios_Breakout4.Rmd (L3B4)</td><td>Indexing Price Series
Index asset
Plot index price</td></tr>
</table>

4	DecribingReturnEDA_Breakout1.Rmd (L4B1)	**Visualize the price and simple returns** Run basic EDA and interpret • Statistics table • Histogram and Relative frequency histograms Percent Ranks Quantile: • Calculate quantile for history returns • Given specific quantile, find corresponding return • Given specific return, find corresponding return
	DecribingReturnEDA_Breakout2.Rmd (L4B2)	**Hunt for outliers** • Via simple visual tools • Via statistical techniques Deal with outliers and rerun EDA with clean data • Deal with outliers: Drop, keep or replace outliers with other values • Rerun EDA for clean data
	DecribingReturnEDA_Breakout3.Rmd (L4B3)	**Rolling Moments** • Compute 250day trailing returns and plot • Compute standard deviation over trailing 250day window and plot • Compute Skewness over trailing 250day window and plot • Compute kurtosis over trailing 250day window and plot
5	DescribingPortfolioReturn_Breakout1.Rmd (L5B1)	**Correlations** • Correlations • Visualize correlations • Correlation overtime
	DescribingPortfolioReturn_Breakout2.Rmd (L5B2)	**Portfolio Analytics: construct buy & hold portfolio consisting of 4 assets** • Chart the weights evolving over time • Pie chart of the avg weights. • Time series plot of portfolio daily returns. • Time series plot of portfolio cumulative return. • Time series plot of drawdown and underwater.

	DescribingPortfolioReturn_Breakout3.Rmd (L5B3)	**Return Distribution**
		• Visualize return distribution via histogram plot
		• Calculate Statistical data for asset's history return distribution
		• Compare it with Normal distribution
		Describing Risk and Return with Distribution Probability
		• Application of Distribution Function
		    o What is the chance of getting a return larger than xx?
		    o What is the chance of getting a return smaller than xx?
		    o What is the chance of getting a return between xx and yy?
		• Application of Quantile Function (Inverse CDF)
		    o If we have a pp probability of getting a return smaller than yy. What is yy?
		    o If we have a pp probability of getting a return larger than yy. What is yy?
		    o If we have a pp probability of getting a return between xx(known) and yy. What is yy?

6	Simulation_Breakout1.Rmd (L6B1)	**Generating Random Numbers from A Specific Distribution** Compare Sample and Population Statistics • Draw N sample observations from population and calculate sample statistics • Increase N and recalculate sample statistics
	Simulation_Breakout2.Rmd (L6B2)	**Simulation Prices** • Simulate random walks prices and plot the implied price process • Repeat simulation for thousands of paths, draw the histogram of ending portfolio values • Repeat above with altered drift • Repeat above with altered noise variance
	Simulation_Breakout3.Rmd (L6B3)	**Resampling Time Series Data - Block Bootstrap** • Sampling from history data • Calculate sample statistics • Repeat for hundreds of times and summary all samples
7	Regression_Breakout1.Rmd (L7B1)	**Ordinary Least Squares (OLS) Regression**: explain the relation between consumer sentiment index and the unemployment rate • Load (1) unemployment (UNRATE) and (2) University of Michigan consumer sentiment index(UMCSENT) data from FRED • EDA • Run simple regression, using UMCSENT as dependent Variable and UNRATE as independent Variable • Summarize regression and interpret regression coefficient(s) • Predict UMCSENT given UNRATE
	Regression_Breakout2.Rmd (L7B2)	**Ordinary Least Squares (OLS) Regression**: running a **log-to-log** form regression to explain the relation (can be interpretation to elasticity) between consumer sentiment index and the unemployment rate • Load (1) unemployment (UNRATE) and (2) University of Michigan consumer sentiment index(UMCSENT) data from FRED • EDA: log(UMCSENT) and log(UNRATE) • Run simple regression, using log(UMCSENT) as dependent Variable and log(UNRATE) as independent Variable • Summarize regression and interpret regression coefficient(s) • Predict log(UMCSENT) given log(UNRATE)

8	CAPM_Breakout1.Rmd (L8B1)	**Capital Asset Pricing Model**: $\left(R_i - R_f\right) = \alpha + \beta\left(R_m - R_f\right)$
		• Estimate CAPM on **single asset**
		• Test hypothesis $H_0: \alpha = 0$
		• Test hypothesis$H_0: \beta > 1$ (stock i is risker than benchmark)
		• Diagnose of CAPM (apply to other OLS models)
		  ○ Linearity: residual with predictor(s)
		  ○ Independence & Equal variance: residual against fitted values and predictor(s)
		  ○ Normality: qq-plot

	CAPM_Breakout2.Rmd (L8B2)	**Capital Asset Pricing Model**: $\left(R_i - R_f\right) = \alpha + \beta\left(R_m - R_f\right)$ • Estimate CAPM for **multiple assets** • Rolling CAPM through time (window size = 2 years) • Plot return vs. beta to get a sense of the Security Market Line

9	Seasonality.Rmd (L9B0)	**Illustrate basic univariate filtering via moving averages and time series decomposition**.

	CAPMSeasonality_Breakout1.Rmd (L9B1)	**CAPM with Seasonality**
		• Estimate CAPM for ONEOK Inc (OKE) and interpret beta and test significance
		• Suppose you thought there might be seasonality for OKE, adjust the seasonality problem using dummy variable
		    ○ Augment the CAPM model to accommodate for seasonality in the **intercept**. Estimate, interpret and test the new coefficients
		    ○ Augment the CAPM model to accommodate for seasonality in the β. Estimate, interpret and test the new coefficients
		    ○ Augment the CAPM model to accommodate for seasonality in the **intercept** and β. Estimate, interpret and test the new coefficients

10	PriceofRisk_Breakout1.Rmd (L10B1)	**Fama-French Three Factor (FF3) Model**:$(R_i - R_f) = \alpha + \beta_m(R_m - R_f) + \beta_s SMB + \beta_v HML$ • Load factor data from Ken French website via FTP • Apply FF3 model to single stock • Interpret the statistical significance and financial meaning of the FF3 • Apply FF3 to another small-cap stock and compare the factor exposures

	PriceofRisk_Breakout2.Rmd (L10B2)	**Fama MacBeth Regression**
		• First-pass regression: Fama-French Five Factor (FF3) $(R_i - R_f) = \alpha + \beta_m(R_m - R_f) + \beta_s SMB + \beta_v HML$
		• Obtain betas $(\beta_m, \beta_s, \beta_v)$ from first-pass regressions
		• Second-pass regression:
		    ○ Re-run the FF3 using betas as independent variables$(R_i - R_f) = \alpha + \lambda_{mkt} b_m + \lambda_{SMB} b_s + \lambda_{HML} b_v$
		    ○ Estimate risk premium lambdas $(\lambda_{mkt}, \lambda_{SMB}, \lambda_{HML})$
		    ○ Hypothesis test for lambdas
		        ▪ Test individual significance
		        ▪ Test if two lambdas are equal
		        ▪ Test joint significance

11	EventStudy_breakout1.Rmd (L11B1)	**Even study**: Biden Election and Bonds (**Single asset, Single Event**) • Asset: 10Yr Yield • Event: Biden Election • Model: local mean of returns • Statistical test
	EventStudy_breakout2.Rmd (L11B2)	**Event study**: Biden Election and Bonds (**Multiple assets, Single Event**) • Asset: Dow 30 Constituents • Event: Biden Election • Model: CAPM market model • Statistical test
12	ReturnForecasts_Breakout1.Rmd (L12B1)	**Forecasting with linear time trends**: $RGDP = \alpha_0 + \alpha_1 Time$ • Train a simple linear time trend model on pre-Covid RGDP (1947->2019) • Static forecast post-Covid RGDP (2020->today) • Draw a graph that overlays actual RGDP with the forecasted RGDP
	ReturnForecasts_Breakout2.Rmd (L12B2)	**Estimating an ARIMA for RGDP**: $\widehat{RGDP}_t = c + \phi_1 RGDP_{d,t-1} + \cdots + \phi_p RGDP_{d,t-p} + \cdots . + \theta_1 e_{t-1} + \cdots . + \theta_q e_{t-q} + e_t$

		• Prior to estimation, you will be checking the RGDP for stationarity and correcting • For unit roots so that the GDP fits the necessary assumptions for an ARIMA.

	ReturnForecasts_Breakout3.Rmd (L12B3)	**Forecasting RGDP with ARIMA**:
		• Use an ARIMA and create a series of dynamic forecasts
		    ○ Fixed Window: Estimate on the training sample. Use the fitted model to do multiquarter forecasts
		    ○ Expanding Window: Estimate on the training sample. Forecast 1 quarter ahead. Use that forecast and forecast another quarter ahead
		    ○ Rolling Window: Set the training sample. Forecast 1 quarter ahead. Roll the training window forward. Forecast another quarter ahead

13	PortfolioAnalytics_PackageIntroduction.Rmd (L13B0)	**Introduce the usage of PortfolioAnalytics package**

	PortfolioOptimalization_Breakout1.Rmd (L13B1)	**Construct Portfolio with Minimal Variance** (given target return)
		• Asset pool: Dow 30 Constituents, use historic sample statistics as inputs
		• Object: Minimize variance subject to target return (compound annual return = 0.15)
		• Constrain: Full invested, long only, no leverage
		• Portfolio performance evaluation
		    ○ Display standard performance data
		    ○ Total Return, Return Stdev
		    ○ Price chart

	PortfolioOptimalization_Breakout2.Rmd (L13B2)	**Construct Portfolio with Maximum Sharpe Ratio**
		• Asset pool: Dow 30 Constituents, use historic sample statistics as inputs
		• Object: Maximize Sharpe Ratio
		• Constrain
		    ○ Full invested, long/short, no leverage
		    ○ Portfolio position number, upper/lower bound of weights
		• Portfolio performance evaluation
		    ○ Display standard performance data
		    ○ Total Return, Return Stdev
		    ○ Price chart

14	AssessPortfolioRisk_Breakout1.Rmd (L14B1)	**Portfolio: Rebalancing vs Re-optimizing**
		• Construct Portfolio with Maximal Sharpe Ratio
		    ○ Asset pool: Dow 30 Constituents, use historic sample statistics as inputs
		    ○ Object: Maximize Sharpe Ratio
		    ○ Constrain: Full invested, long only, no leverage
		• Compare the Following Investment Strategy
		    ○ Buy and Hold
		    ○ Monthly Rebalance
		    ○ Monthly Rebalance + Monthly Re-optimize

	AssessPortfolioRisk_Breakout2.Rmd (L14B2)	**Construct Risk Parity Portfolio** • Asset pool: Dow 30 Constituents, use historic sample statistics as inputs • Object: Risk Parity • Constrain: Full invested, long only, no leverage