SFU

Beedie School of Business

BUS 865 Market Risk Management

Linear Regression:
Prediction for Next Quarter One Year GDP Growth

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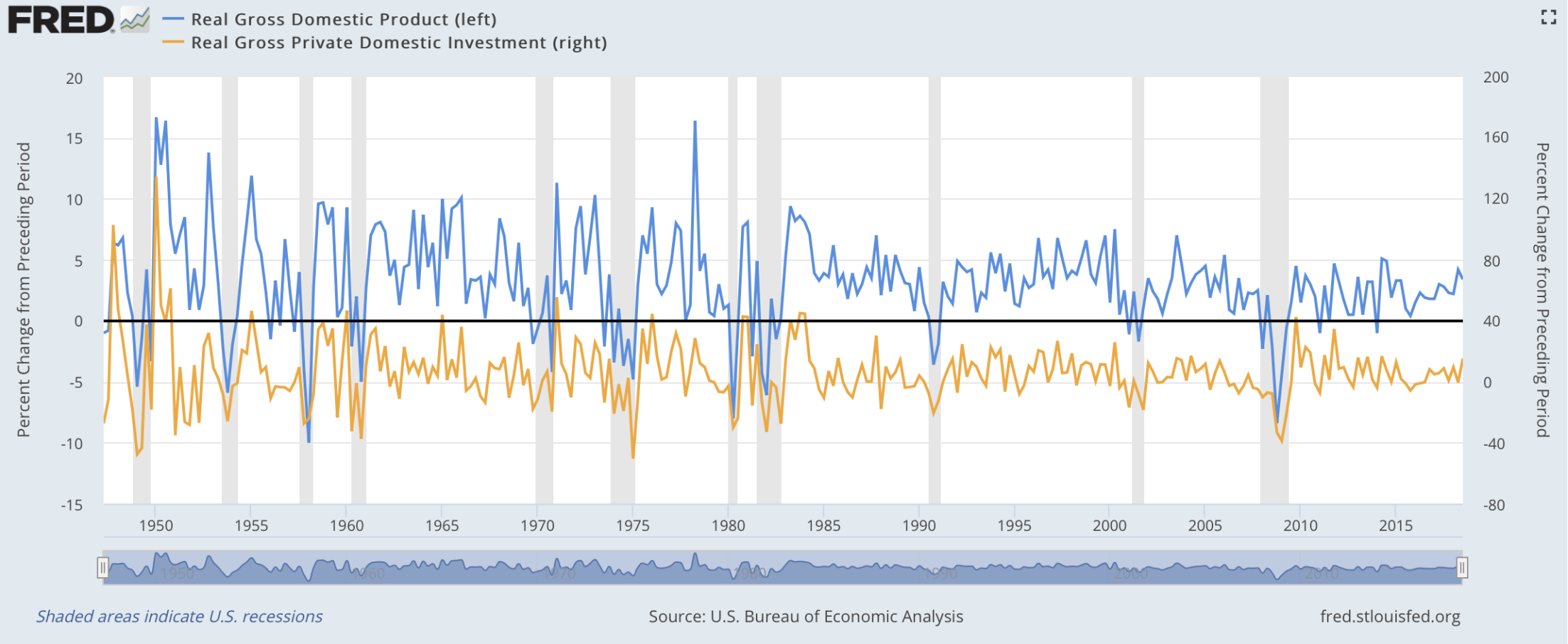
X1 : Private Domestic Investment Growth

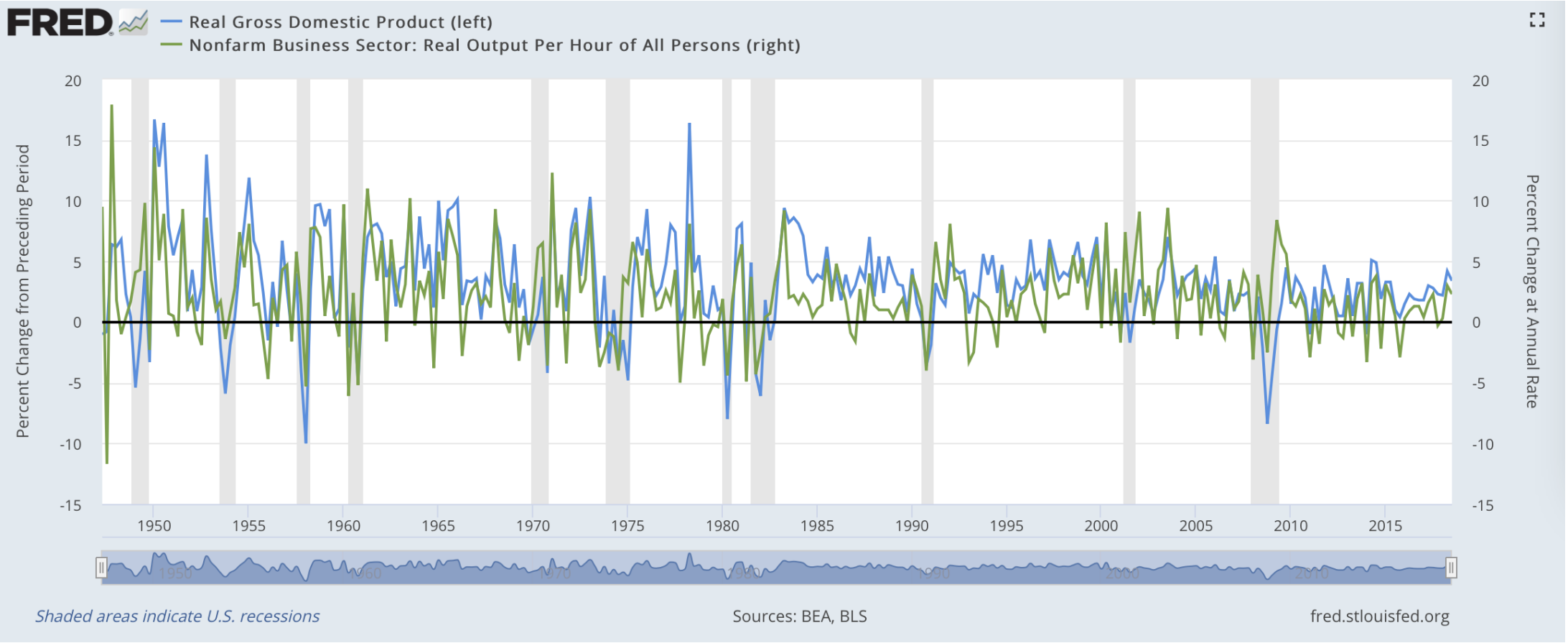
NOTATION	VARIABLES	NAME	UNIT	FREQUENCY
Y	GDPgrowth	Real Gross Domestic Product	Percent Change from Preceding Period, Seasonally Adjusted Annual Rate	Quarterly
X1	PrivateInvest	Real Gross Private Domestic Investment	Percent Change from Preceding Period, Seasonally Adjusted Annual Rate	Quarterly



X2 : Output Per Hour Growth

Reflection of investment in better technology and skills; More revenue and higher wages.

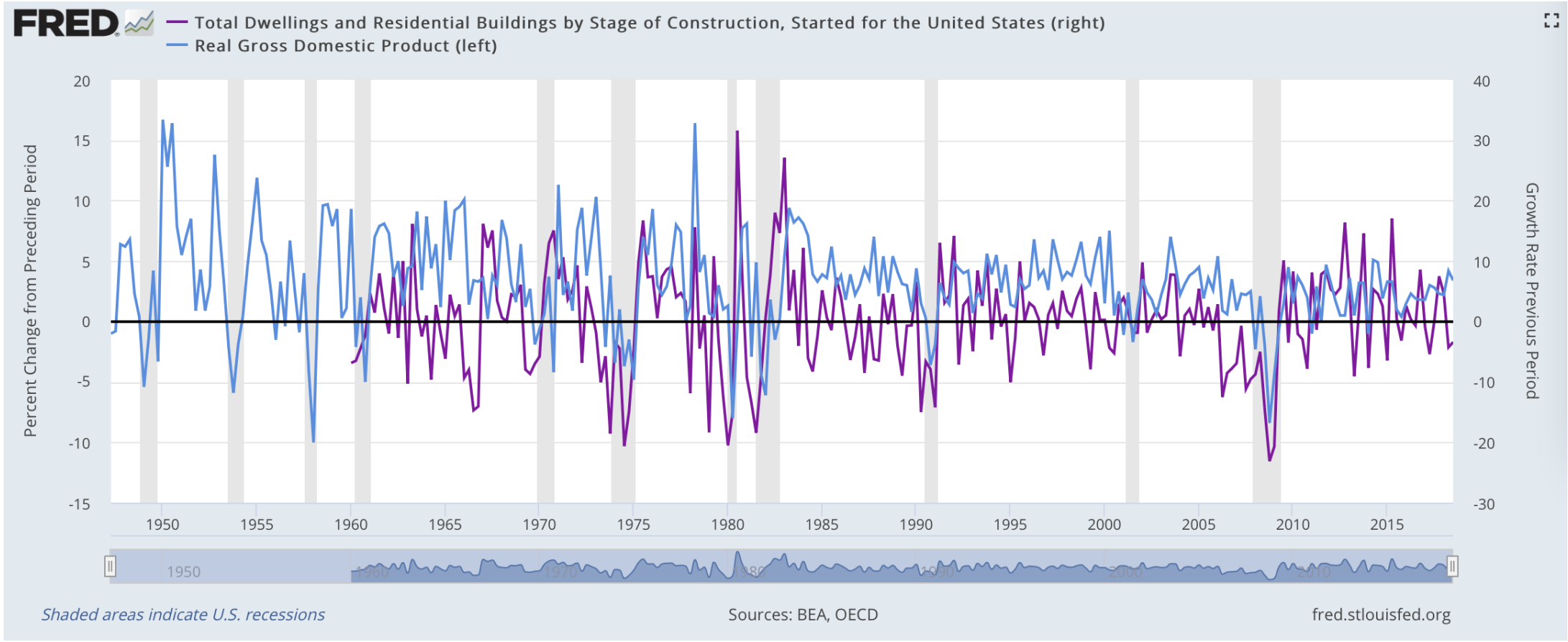
NOTATION	VARIABLES	NAME	UNIT	FREQUENCY
Y	GDPgrowth	Real Gross Domestic Product	Percent Change from Preceding Period, Seasonally Adjusted Annual Rate	Quarterly
X2	OutputperHr	Real Output Per Hour of All Persons (nonfarm)	Percent Change at Annual Rate, Seasonally Adjusted	Quarterly



X3 : Buildings by Stage of Construction Growth

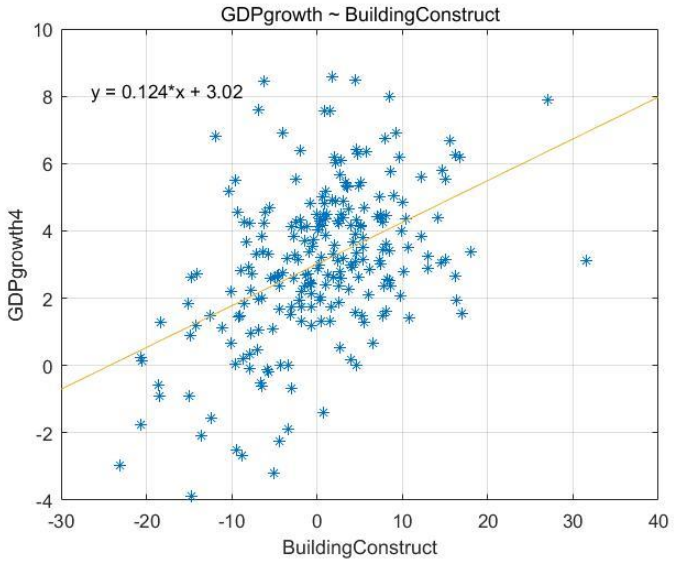
Biggest investment; Reflection of consumer confidence

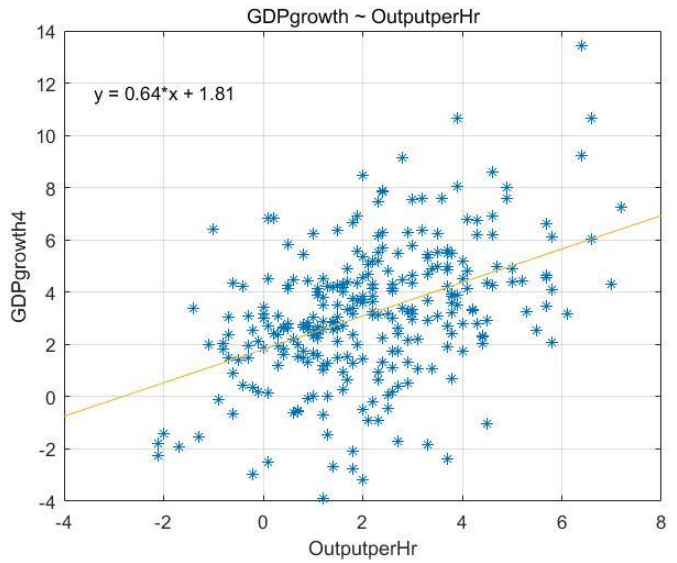
NOTATION	VARIABLES	NAME	UNIT	FREQUENCY
Y	GDPgrowth	Real Gross Domestic Product	Percent Change from Preceding Period, Seasonally Adjusted Annual Rate	Quarterly
X3	BuildingConstruct	Total Dwellings and Residential Buildings by Stage of Construction	Growth Rate Previous Period, Seasonally Adjusted	Quarterly

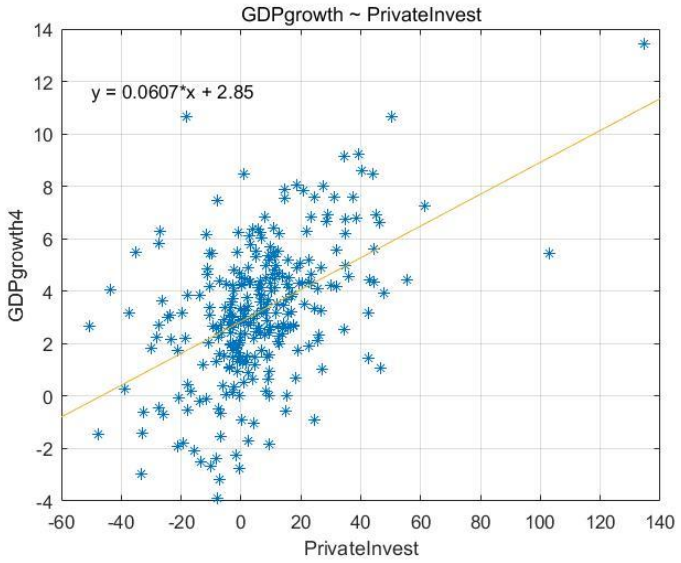


Simple Linear Regression

Variable	Linear Regression Model	Estimate	tStat	pValue	SE	R-Squared	Adj R-Squared	95% CI	# of Observations
BuildingConstruct	$GDPGrowth_{t:t+4} = a + b * BuildingConstruct_t + u_{t+4}$	a=3.04	23.58	0.00	0.13	0.223	0.22	(2.78, 3.30)	232
		b=0.12	8.13	0.00	0.02			(0.08, 0.16)	
OutputperHr	$GDPGrowth_{t:t+4} = a + b * OutputperHr_t + u_{t+4}$	a=1.97	9.29	0.00	0.21	0.181	0.178	(1.55, 2.39)	280
		b=0.59	7.83	0.00	0.08			(0.43, 0.75)	
PrivateInvest	$GDPGrowth_{t:t+4} = a + b * PrivateInvest_t + u_{t+4}$	a=2.87	20.78	0.00	0.14	0.261	0.258	(2.59, 3.15)	283
		b=0.06	9.95	0.00	0.01			(0.04, 0.08)	







Coding and Data (Jan 1st 1960 – July 31st 2018)

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%% Import data

GDP = readtable('A191RL1Q225SBEA.xls');

%Total Dwellings and Residential Buildings by Stage of Construction,
%Started for the United States, Growth Rate Previous Period, Quarterly,
%Seasonally Adjusted
building = readtable('WSCNDW01USQ657S.xls');

%Real Gross Private Domestic Investment, Percent Change from
%Preceding Period, Quarterly, Seasonally Adjusted Annual Rate
investment = readtable('A006RL1Q225SBEA.xls');

%Nonfarm Business Sector: Real Output Per Hour of All Persons,
%Percent Change From Quarter One Year Ago, Quarterly,
%Seasonally Adjusted
outputphour = readtable('PRS85006091.xls');
```

1 DATE	2 GDPgrowth	3 BuildingConstruct	4 PrivateInvest	5 OutputperHr	6 GDPgrowth4
01-Jan-1960	9.3000	-6.8618	46.7000	3.1000	1.0500
01-Apr-1960	-2.1000	-6.5079	-32.4000	0.6000	-0.6000
01-Jul-1960	2	-4.4392	-1	1	1.6750
01-Oct-1960	-5	-2.2815	-37.5000	0	3.1500
01-Jan-1961	2.7000	4.6695	10.8000	-1	6.4250
01-Apr-1961	7	1.4781	31.1000	3.2000	7.5750
01-Jul-1961	7.9000	7.9449	34.9000	4.3000	6.7500
01-Oct-1961	8.1000	2.1835	6.8000	6.6000	6.0250
01-Jan-1962	7.3000	-1.9928	23.4000	7	4.3250
01-Apr-1962	3.7000	8.0598	-3.1000	3.8000	3.6000
01-Jul-1962	5	-2.7205	6.9000	3.8000	3.8250
01-Oct-1962	1.3000	9.9744	-11.2000	3.7000	4.8500

```
%% Model 1 : GDPgrowth ~ BuildingConstruct + OutputperHr + PrivateInvest

data_var3 = innerjoin(innerjoin(innerjoin(GDP,building),investment),outputphour);
T_var3 = length(data_var3.GDPgrowth);
data_var3.GDPgrowth4 = zeros(T_var3,1);
data_var3.GDPgrowth4(1:T_var3-3) = (data_var3.GDPgrowth(1:T_var3-3) + ...
                                    data_var3.GDPgrowth(2:T_var3-2) + ...
                                    data_var3.GDPgrowth(3:T_var3-1) + ...
                                    data_var3.GDPgrowth(4:T_var3))/4;
LM_var3_a = fitlm(data_var3(1:T_var3-3,:),...
                  'GDPgrowth4~BuildingConstruct + OutputperHr + PrivateInvest',...
                  'RobustOpts','on');
```

3 Variables Linear Regression MATLAB Results

```
Linear regression model (robust fit):
    GDPgrowth4 ~ 1 + BuildingConstruct + PrivateInvest + OutputperHr

Estimated Coefficients:
```

	Estimate	SE	tStat	pValue	95% CI
(Intercept)	2.13	0.18	11.88	0.00	(1.77 , 2.49)
BuildingConstruct	0.10	0.01	6.94	0.00	(0.08 , 0.12)
PrivateInvest	0.04	0.01	4.60	0.00	(0.02 , 0.06)
OutputperHr	0.35	0.07	4.81	0.00	(0.21 , 0.49)

```
Number of observations: 232, Error degrees of freedom: 228
Root Mean Squared Error: 1.75
R-squared: 0.399,  Adjusted R-Squared 0.391
F-statistic vs. constant model: 50.5, p-value = 4.53e-25
```

- tStats of each estimate are positive and greater than 2;
- p-Value less than 5% -> reject null hypothesis;
- 95% CI of each estimate far from zero, high correlations between independent and dependent variables;
- Therefore, estimate coefficients of the three independent variables are statistically significant and the regression model reflects 39.1% variability of data;

Conclusion & Other Thoughts

$$GDPGrowth_{t:t+4} = 2.13 + 0.1 * BuildingConstruct_t + 0.04 * PrivateInvest_t + 0.35 * OutputperHr_t + u_{t+4}$$

- This equation shows the coefficients for variables BuildingConstruct, PrivateInvest and OutputperHr are 0.1, 0.04 and 0.35 correspondingly.
- It indicates that for every additional 1% change in each variable, we can expect GDP to increase by average of 0.1%, 0.04% and 0.35% correspondingly.

Thoughts & Improvements

- The impact on GDP growth decreases as we include all three variables in the model.
- Future Improvement:
  - Test independence between each variable.
  - Run F test for additional variable.

Thank you!

Q & A