Homework 2

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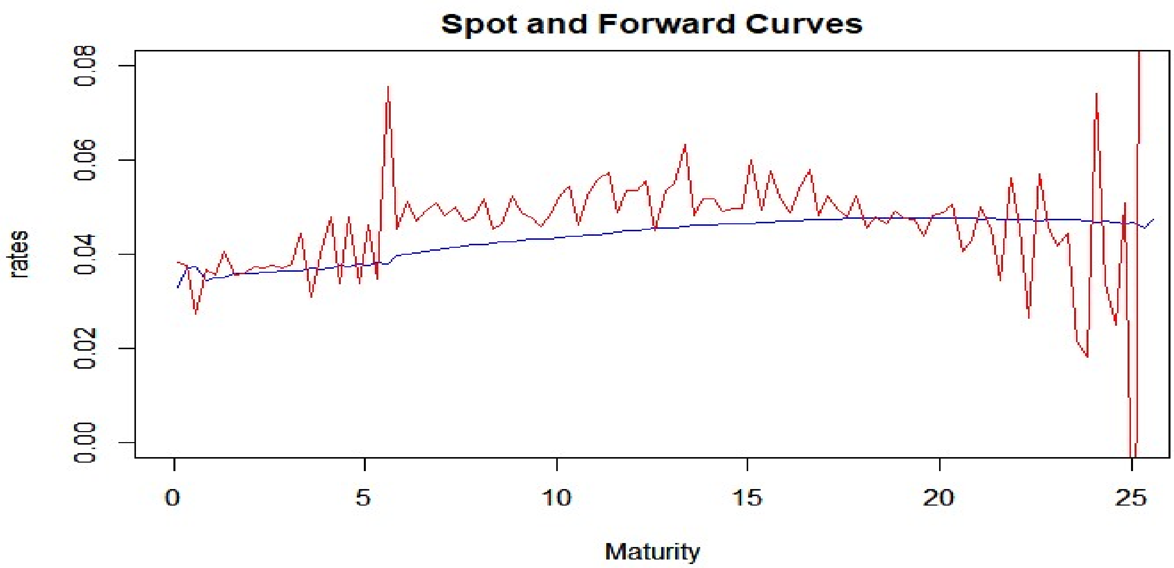
1. Using the raw STRIPS data, graph the spot curve and the 3-months forward curve out to the longest maturity of the data.

The spot curve is shown as the blue curve and the 3-months forward curve is shown in red.



2. Assume that the discount function can be expressed by the following polynomial function

$$D(T) = \exp\left(aT + bT^2 + cT^3 + dT^4 + eT^5\right)$$

Using the STRIPS data, estimate the coefficients a,b,c,d, and e by regressing the log of D(T) on the indicated power of T.

SUMMARY OUTPUT

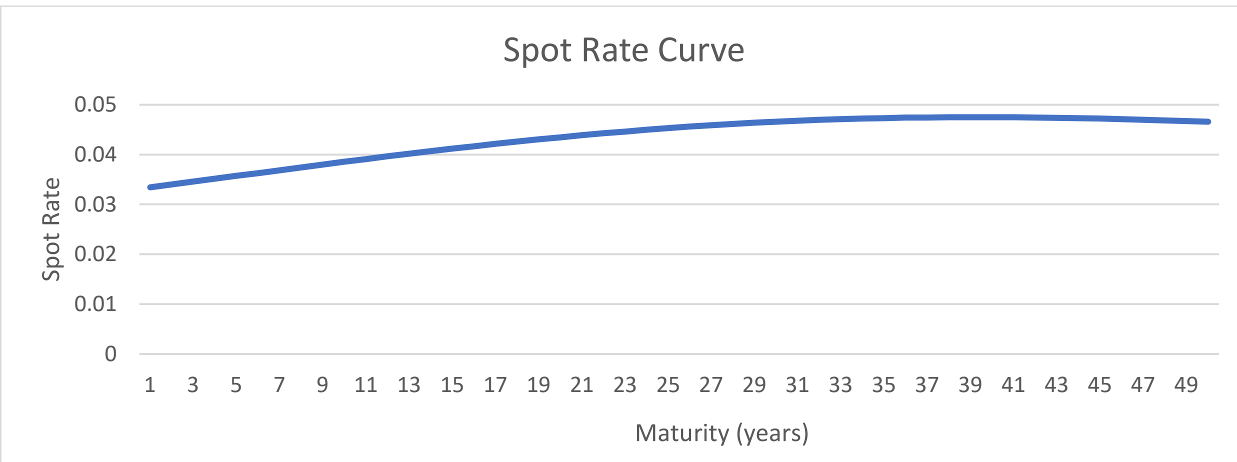
Regression Statistics	
Multiple R	0.99998523
R Square	0.99997046
Adjusted R Sq	0.98976517
Standard Erro	0.00380208
Observations	103

ANOVA

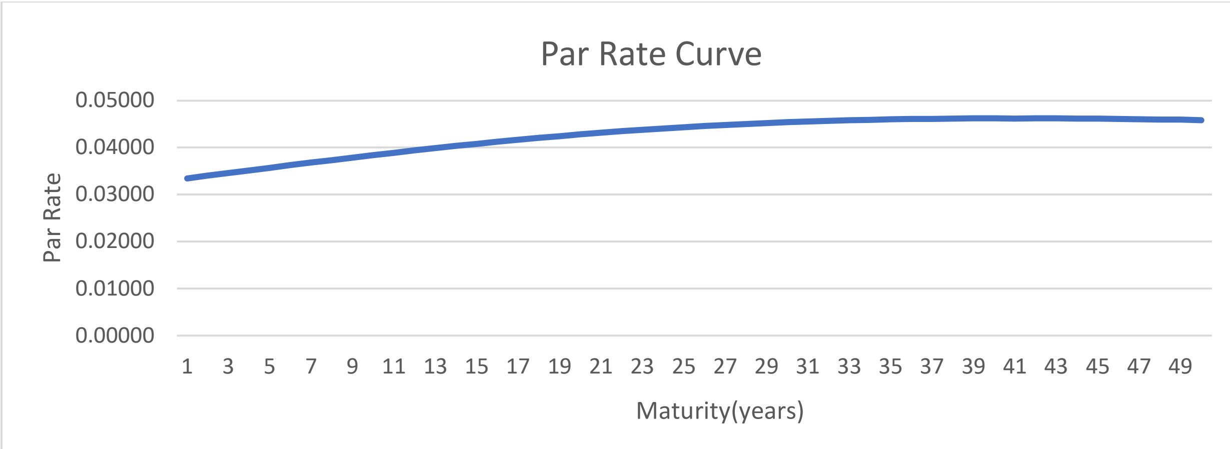
	df	SS	MS	F	Significance F
Regression	5	47.9559858	9.59119717	663484.778	3.315E-218
Residual	98	0.00141667	1.4456E-05		
Total	103	47.9574025			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
X Variable 1	-0.032628	0.00088448	-36.8896288	2.8421E-59	-0.03438326	-0.03087283	-0.03438326	-0.03087283
X Variable 2	-0.0010747	0.00028433	-3.77979017	0.00026974	-0.00163895	-0.00051046	-0.00163895	-0.00051046
X Variable 3	-1.981E-05	3.1554E-05	-0.62787752	0.53154459	-8.243E-05	4.2806E-05	-8.243E-05	4.2806E-05
X Variable 4	2.8237E-06	1.4436E-06	1.95604128	0.05330733	-4.1035E-08	5.6884E-06	-4.1035E-08	5.6884E-06
X Variable 5	-4.682E-08	2.3284E-08	-2.01073907	0.04710028	-9.3023E-08	-6.117E-10	-9.3023E-08	-6.117E-10

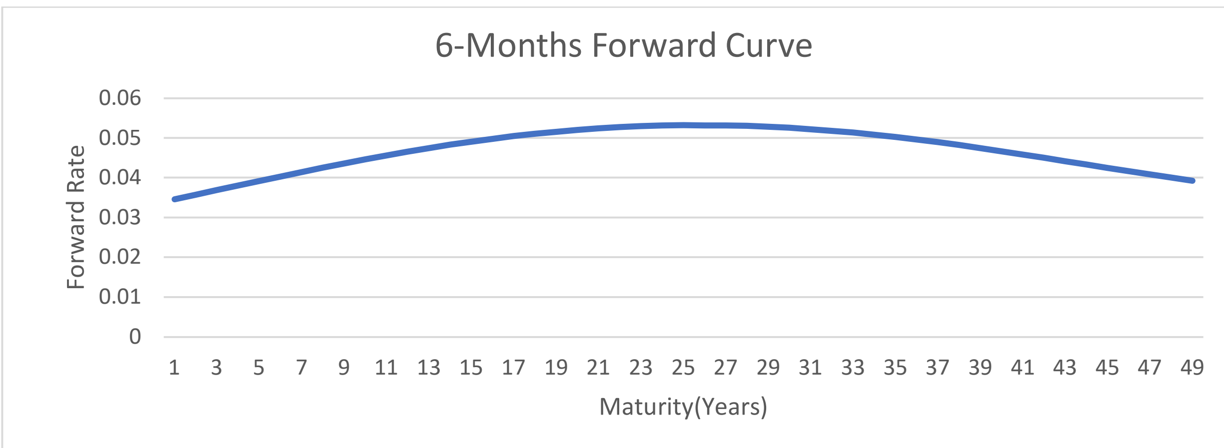
3. Plug the estimated coefficients back into the D(T) function and graph the resulting spot curve at semiannual frequencies out to 25 years.



4. Using the estimated discount function, solve for the par rates at semiannual frequencies out to 25 years. Graph these rates.



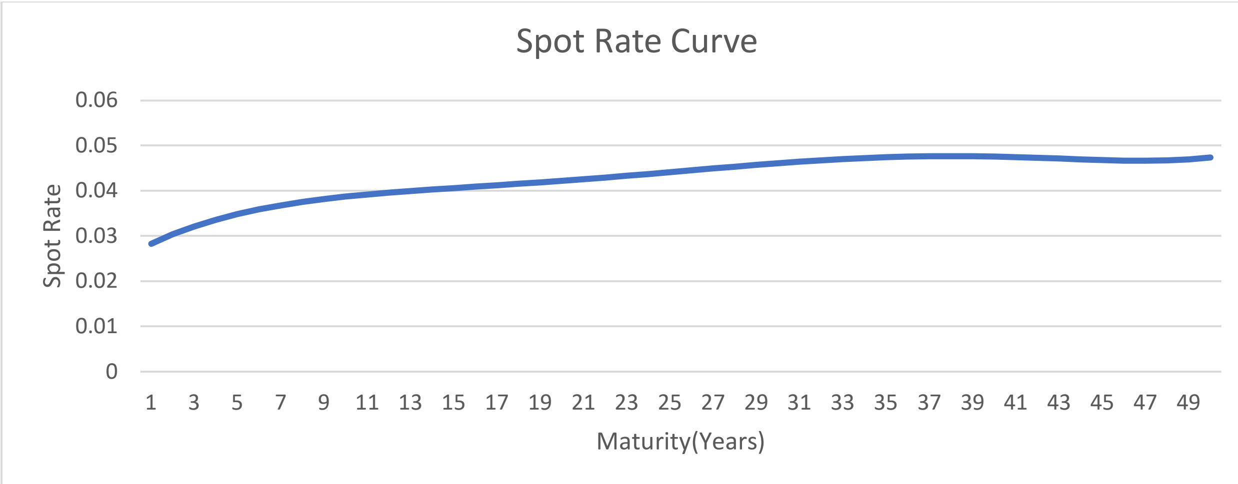
5. Using the estimated discount function, solve for the 6-month forward rates at semiannual frequencies out to 25 years. Graph these rates.

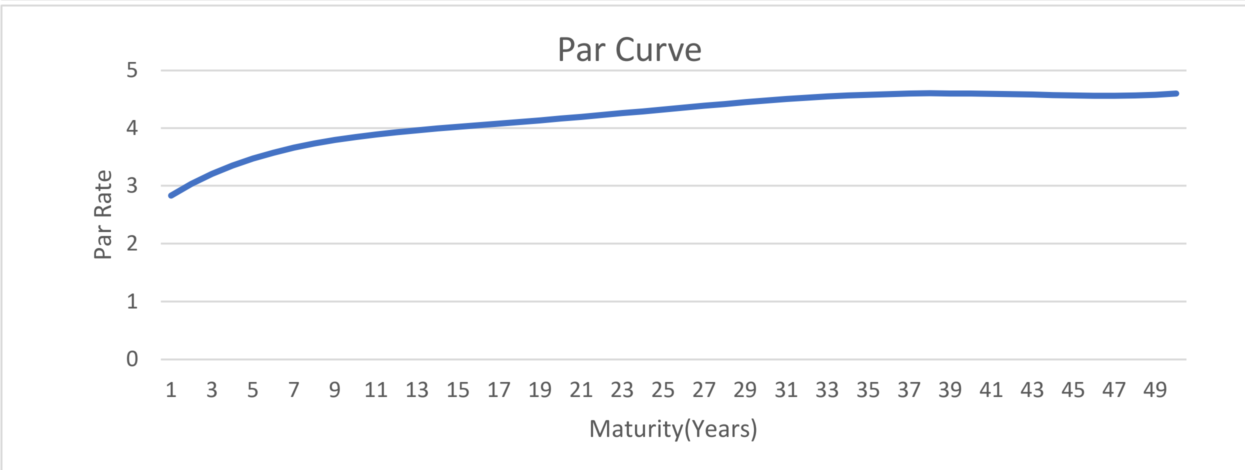


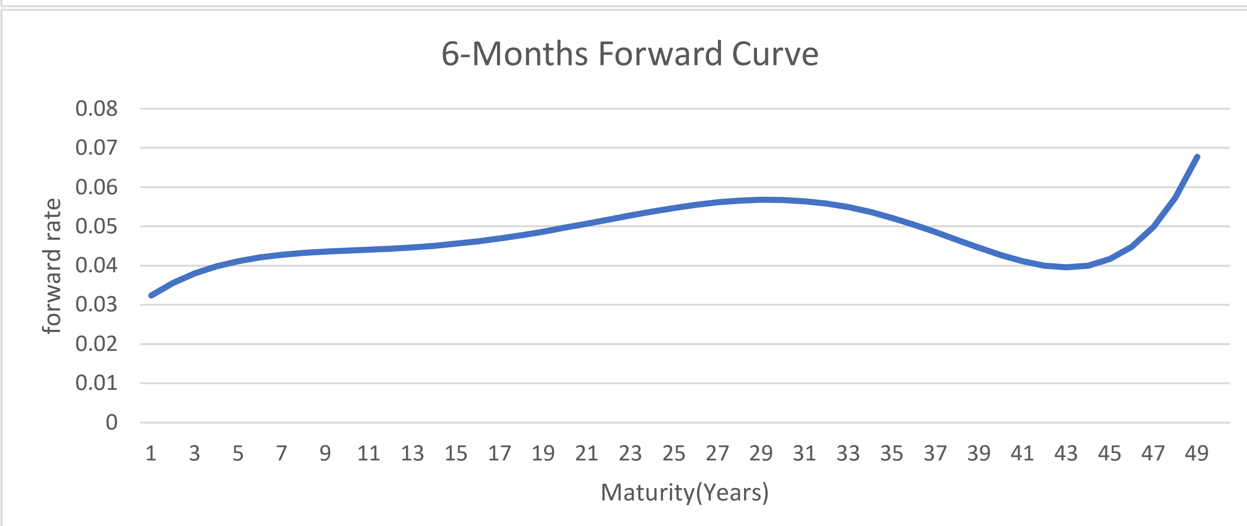
6. Assume that the par curve for maturity T is given by the following function

$$Y(T) = a + bT + cT^2 + dT^3 + eT^4 + fT^5$$

Using the Treasury note and bond data, bootstrap the spot curve. From the bootstrapped curve, graph the resulting spot curve, par curve, and 6-month forward curve out to 25 years.


Spot Rate Curve
Spot Rate
0.06
0.05
0.04
0.03
0.02
0.01
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49
Maturity(Years)


Par Curve
Par Rate
5
4
3
2
1
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49
Maturity(Years)


6-Months Forward Curve
forward rate
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49
Maturity(Years)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.99470477
R Square	0.98943758
Adjusted R Sq	0.9886124
Standard Error	0.05664792
Observations	70

ANOVA

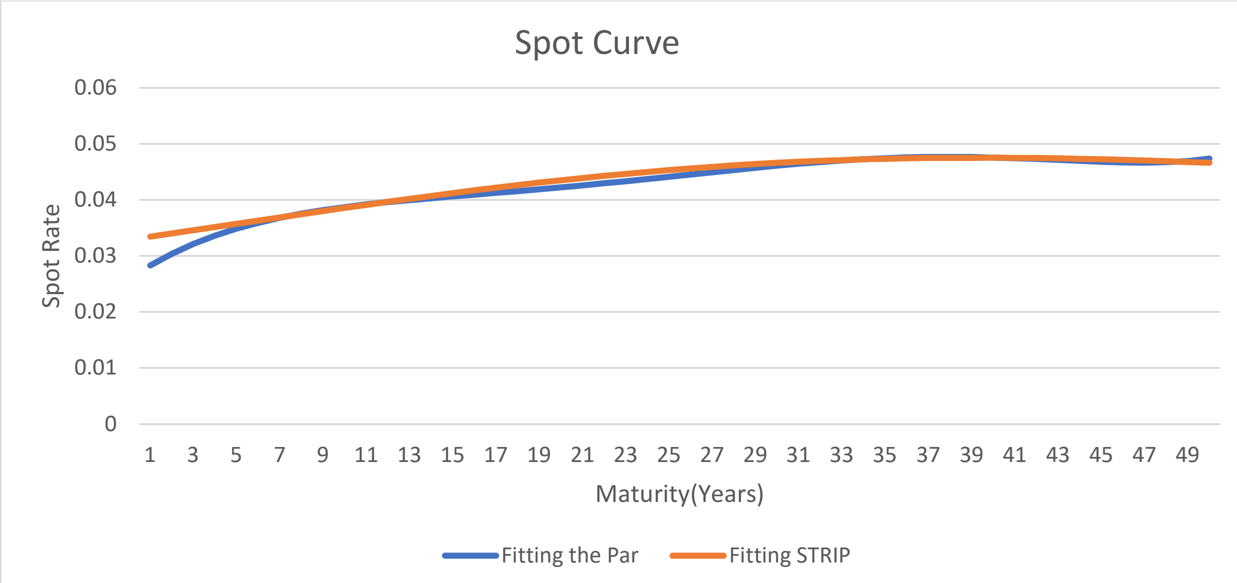
	df	SS	MS	F	Significance F
Regression	5	19.2385812	3.84771624	1199.04402	8.1797E-62
Residual	64	0.20537514	0.00320899		
Total	69	19.4439563			

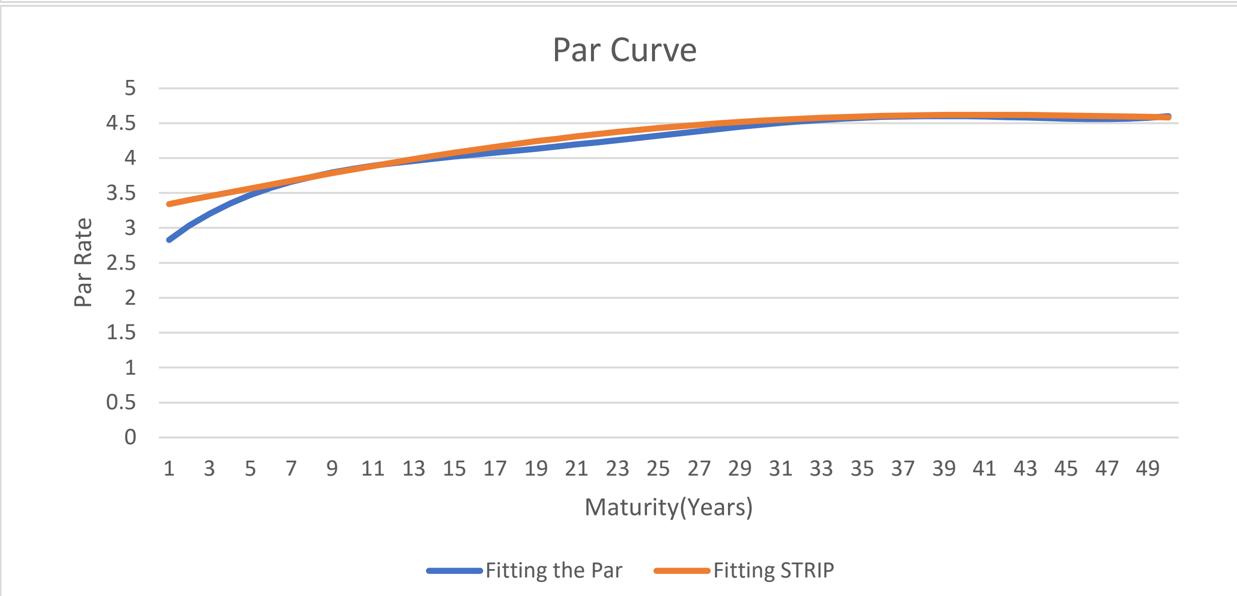
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2.59435748	0.03380364	76.7478808	1.0064E-64	2.52682695	2.66188801	2.52682695	2.66188801
X Variable 1	0.51265259	0.02855804	17.951252	1.1305E-26	0.45560134	0.56970383	0.45560134	0.56970383
X Variable 2	-0.07942522	0.00731283	-10.8610771	3.6819E-16	-0.09403428	-0.06481616	-0.09403428	-0.06481616
X Variable 3	0.00654589	0.00076326	8.57623765	3.1215E-12	0.0050211	0.00807067	0.0050211	0.00807067
X Variable 4	-0.00025168	3.4486E-05	-7.2980696	5.5678E-10	-0.00032058	-0.00018279	-0.00032058	-0.00018279
X Variable 5	3.5701E-06	5.6047E-07	6.36977939	2.3393E-08	2.4504E-06	4.6897E-06	2.4504E-06	4.6897E-06

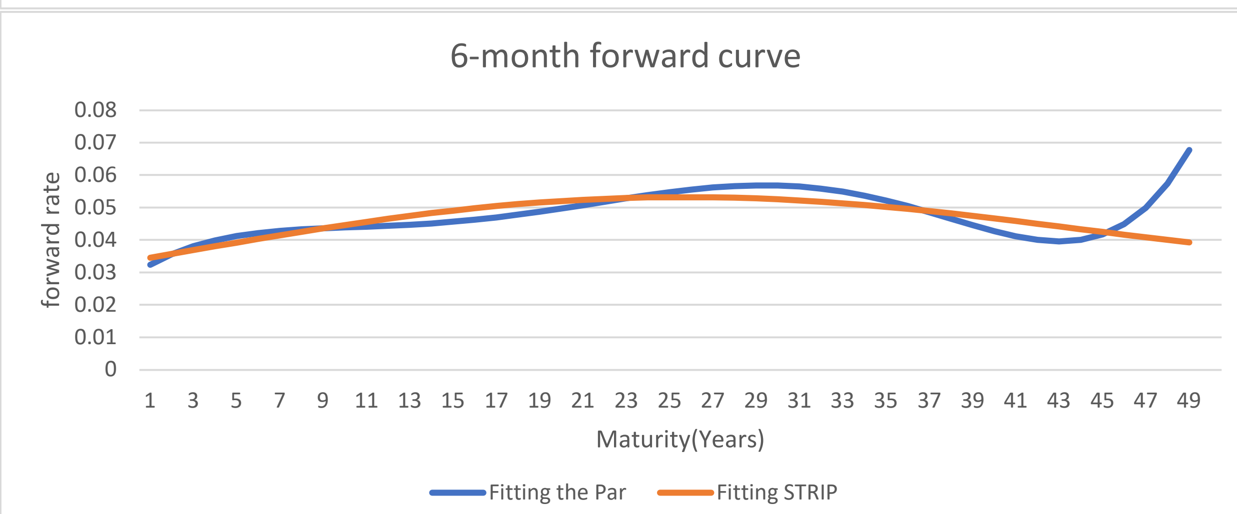
7. Compare the spot, par, and forward curves from fitting the STRIPS curve with those from fitting the Par Curve. What do you attribute the differences to?

According to the graphs below, we can see that the spot rate curve and par rate curve for the STRIPS (Red line) and T-notes (Blue line) has a similar pattern with close values and STRIPS curves are slightly higher than those for the Treasury Note curves in most of the time. However, the 6-month forward curve from fitting the Treasury Note Par Rate Curve has a lot of volatility while the 6-month forward curve from fitting the STRIPS curve is smoother and less erratic. This is because the STRIPS are basically zero-coupon bonds that have a complete range of maturities, thus have less idiosyncratic variation when compared to less liquid Treasury Note or Bond.

However, for the short-term rates, the spot rate and par rate curves derived from STRIPS seem to over-estimate the rates when compared to the curves derived from fitting the Treasury Note par curve. This is due to the limited liquidity of STRIPS at shorter maturities.


Spot Curve
0.06
0.05
0.04
0.03
0.02
0.01
0
Spot Rate
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49
Maturity(Years)
Fitting the Par
Fitting STRIP


Par Curve
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Par Rate
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49
Maturity(Years)
Fitting the Par
Fitting STRIP


6-month forward curve
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
forward rate
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49
Maturity(Years)
Fitting the Par
Fitting STRIP