Thangkrit 6204640087

Assignment 5

1. In the study of interest rate structure, the continuous time model can be specified as:

$$r_{t+\Delta t} - r_t = (\alpha + \beta r_t)\Delta t + \varepsilon_{t+\Delta t} \tag{1}$$

where: $E[\varepsilon_{t+\Delta t}] = 0$ and $E[\varepsilon^2_{t+\Delta t}] = \sigma^2 r_t^{2\gamma} \Delta t$

Then, the model can be transformed to be discrete time model by setting $\Delta t = 1$. The discrete time model can be stated as:

$$r_{t+1} - r_t = \Delta r_t = \alpha + \beta r_t + \varepsilon_{t+1} \tag{2}$$

where: $E[\varepsilon_{t+1}] = 0$ and $E[\varepsilon^2_{t+1}] = \sigma^2 r_t^{2\gamma}$

The above model consists of four parameters including $\alpha, \beta, \sigma^2, \gamma$. The model can be estimate using GMM. Four moment condition equations can be stated as:

Zero mean condition: $E(\varepsilon_{t+1}) = 0$

Orthogonality condition: $E(\varepsilon_{t+1} r_t) = 0$

Variance condition: $E(\varepsilon^2_{t+1} - \sigma^2 r_t^{2\gamma}) = 0$

Zero covariance condition: $E\left(\left(\varepsilon^2_{t+1} - \sigma^2 r_t^{2\gamma}\right) r_t\right) = 0$

The above model can be claimed as unrestricted model for other eight interest rate structure models which can be indicated as follows:

Model	α	β	σ^2	γ
(1) Unrestricted				
(2) Merton		0		0
(3) Vasicek				0
(4) CIR SR				0.5
(5) Dothan	0	0		1
(6) GBM	0			1
(7) Brennan & Schwartz				1
(8) CIR VR	0	0		1.5
(9) CEV	0			

From the given data set (`assign5-1.dta`):

a. Estimate the interest rate structure models applying all 9 models using GMM. Also perform Overidentification Test. (Hint: command for generating $\Delta r_t = r_{t+1} - r_t$ is `gen dr=f.r-r`)

b. Determine the most appropriated model using Wald Test.

```
                                                      ___  ____  ____  ____  ____(R)
                                                     /__    /   ____/   /   ____/
                                                    ___/   /   /___/   /   /___/
                                                      Statistics/Data Analysis
```

```
  ___  ____  ____  ____  ____ (R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   14.0   Copyright 1985-2015 StataCorp LP
  Statistics/Data Analysis            StataCorp
                                      4905 Lakeway Drive
     MP - Parallel Edition            College Station, Texas 77845 USA
                                      800-STATA-PC        http://www.stata.com
                                      979-696-4600        stata@stata.com
                                      979-696-4601 (fax)

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         Licensed to:  T


Notes:
      1.  Unicode is supported; see help unicode advice.
      2.  More than 2 billion observations are allowed; see help obs advice.
      3.  Maximum number of variables is set to 5000; see help set_maxvar.

. use "C:\Users\Chaiyapong M\Desktop\BE\EE426\Assignment 5\assign5-1.dta", clear

. do "C:\Users\CHAIYA~1\AppData\Local\Temp\STD00000000.tmp"
```

(a)

```
. gen dr = f.r-r
(1 missing value generated)

. gmm (dr-{alpha}-{beta}*r) ((dr-{alpha}-{beta}*r)*r) ((dr-{alpha}-{beta}*r)^2-{sigma2}*r^(2*{gamma})) (((dr-{alpha}-{beta}*r)^2-{sigma2}*r^(2*{gamma}))*r) winitia
note: 1 missing value returned for equation 1 at initial values
note: 1 missing value returned for equation 2 at initial values
note: 1 missing value returned for equation 3 at initial values
note: 1 missing value returned for equation 4 at initial values
```

• Unrestricted

```
Step 1
numerical derivatives are approximate
flat or discontinuous region encountered
Iteration 0:   GMM criterion Q(b) =  .00001173
Iteration 1:   GMM criterion Q(b) =  8.321e-06  (backed up)
Iteration 2:   GMM criterion Q(b) =  6.043e-06  (not concave)
Iteration 3:   GMM criterion Q(b) =  1.604e-06
Iteration 4:   GMM criterion Q(b) =  1.662e-09
Iteration 5:   GMM criterion Q(b) =  1.344e-13

Step 2
Iteration 0:   GMM criterion Q(b) =  3.899e-10
Iteration 1:   GMM criterion Q(b) =  4.098e-18

note: model is exactly identified

GMM estimation
```

```
Number of parameters =   4
Number of moments    =   4
Initial weight matrix: Identity                   Number of obs   =      1,334
GMM weight matrix:     Robust

------------------------------------------------------------------------------
             |               Robust
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      /alpha |  -.0023725   .0011574    -2.05   0.040    -.0046409   -.0001041
       /beta |   .0004291   .0002873     1.49   0.135     -.000134    .0009922
     /sigma2 |   .0005043    .000324     1.56   0.120    -.0001307    .0011393
      /gamma |   .0985177   .1823933     0.54   0.589    -.2589666     .456002
------------------------------------------------------------------------------
Instruments for equation 1: _cons
Instruments for equation 2: _cons
Instruments for equation 3: _cons
Instruments for equation 4: _cons

. estimates store unres

. gmm (dr-{alpha}) ((dr-{alpha})*r) ((dr-{alpha})^2-{sigma2}) (((dr-{alpha})^2-{sigma2})*r) winitial(identity)
note: 1 missing value returned for equation 1 at initial values
note: 1 missing value returned for equation 2 at initial values
note: 1 missing value returned for equation 3 at initial values
note: 1 missing value returned for equation 4 at initial values

Step 1
Iteration 0:   GMM criterion Q(b) =  .00001173
Iteration 1:   GMM criterion Q(b) =  4.045e-08
Iteration 2:   GMM criterion Q(b) =  4.044e-08

Step 2
Iteration 0:   GMM criterion Q(b) =  .00798141
Iteration 1:   GMM criterion Q(b) =  .00552368
Iteration 2:   GMM criterion Q(b) =  .00552368

GMM estimation

Number of parameters =   2
Number of moments    =   4
Initial weight matrix: Identity                   Number of obs   =      1,334
GMM weight matrix:     Robust
```

• Merton

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
/alpha	-.0008137	.0006821	-1.19	0.233	-.0021507	.0005232
/sigma2	.0004277	.0002902	1.47	0.141	-.0001412	.0009965

```
Instruments for equation 1: _cons
Instruments for equation 2: _cons
Instruments for equation 3: _cons
Instruments for equation 4: _cons

. estat overid

  Test of overidentifying restriction:

  Hansen's J chi2(2) = 7.36859 (p = 0.0251)
```

< 0.05

```
. estimates store merton

. gmm (dr-{alpha}-{beta}*r) ((dr-{alpha}-{beta}*r)*r) ((dr-{alpha}-{beta}*r)^2-{sigma2}) (((dr-{alpha}-{beta}*r)^2-{sigma2})*r) winitial(identity)
note: 1 missing value returned for equation 1 at initial values
note: 1 missing value returned for equation 2 at initial values
note: 1 missing value returned for equation 3 at initial values
note: 1 missing value returned for equation 4 at initial values
```

• Vasicek

```
Step 1
Iteration 0:   GMM criterion Q(b) =  .00001173
Iteration 1:   GMM criterion Q(b) =  3.336e-10
Iteration 2:   GMM criterion Q(b) =  3.273e-10

Step 2
Iteration 0:   GMM criterion Q(b) =  .00063051
Iteration 1:   GMM criterion Q(b) =  .00020488
Iteration 2:   GMM criterion Q(b) =  .00020488

GMM estimation

Number of parameters =   3
Number of moments    =   4
Initial weight matrix: Identity                Number of obs   =      1,334
GMM weight matrix:     Robust
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
/alpha	-.0026994	.0009734	-2.77	0.006	-.0046072	-.0007915
/beta	.0005368	.0001999	2.69	0.007	.000145	.0009286
/sigma2	.0005887	.0002977	1.98	0.048	5.20e-06	.0011722

```
Instruments for equation 1: _cons
Instruments for equation 2: _cons
Instruments for equation 3: _cons
Instruments for equation 4: _cons
```

```
. estat overid

  Test of overidentifying restriction:

  Hansen's J chi2(1) = .273315 (p = 0.6011)

. estimates store vas

. gmm (dr-{alpha}-{beta}*r) ((dr-{alpha}-{beta}*r)*r) ((dr-{alpha}-{beta}*r)^2-{sigma2}*r) (((dr-{alpha}-{beta}*r)^2-{sigma2}*r)*r) winitial(identity)
note: 1 missing value returned for equation 1 at initial values
note: 1 missing value returned for equation 2 at initial values
note: 1 missing value returned for equation 3 at initial values
note: 1 missing value returned for equation 4 at initial values
```

• CIR SR

```
Step 1
Iteration 0:   GMM criterion Q(b) =  .00001173
Iteration 1:   GMM criterion Q(b) =  3.349e-09
Iteration 2:   GMM criterion Q(b) =  3.343e-09

Step 2
Iteration 0:   GMM criterion Q(b) =  .00651703
Iteration 1:   GMM criterion Q(b) =  .00164197
Iteration 2:   GMM criterion Q(b) =  .00164196

GMM estimation

Number of parameters =   3
Number of moments    =   4
Initial weight matrix: Identity                   Number of obs   =      1,334
GMM weight matrix:     Robust
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
/alpha	-.0010252	.0007112	-1.44	0.149	-.0024191	.0003686
/beta	.0002288	.0002532	0.90	0.366	-.0002675	.000725
/sigma2	.0000917	.0000646	1.42	0.156	-.000035	.0002183

```
Instruments for equation 1: _cons
Instruments for equation 2: _cons
Instruments for equation 3: _cons
Instruments for equation 4: _cons
```

```
. estat overid

  Test of overidentifying restriction:

  Hansen's J chi2(1) = 2.19038 (p = 0.1389)

. estimates store cir_sr

. gmm (dr) (dr*r) (dr^2-{sigma2}*r^2) ((dr^2-{sigma2}*r^2)*r) winitial(identity)
note: no parameters in equation 1
note: no parameters in equation 2
note: 1 missing value returned for equation 1 at initial values
note: 1 missing value returned for equation 2 at initial values
note: 1 missing value returned for equation 3 at initial values
note: 1 missing value returned for equation 4 at initial values

Step 1
Iteration 0:   GMM criterion Q(b) =  .00001173
Iteration 1:   GMM criterion Q(b) =  5.688e-06
Iteration 2:   GMM criterion Q(b) =  5.688e-06

Step 2
Iteration 0:   GMM criterion Q(b) =  .00932249
Iteration 1:   GMM criterion Q(b) =  .00344401
Iteration 2:   GMM criterion Q(b) =  .00344401

GMM estimation

Number of parameters =   1
Number of moments    =   4
Initial weight matrix: Identity                 Number of obs   =      1,334
GMM weight matrix:     Robust
```

• Dothan

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
/sigma2	.0000162	7.20e-06	2.25	0.025	2.08e-06	.0000303

```
Instruments for equation 1: _cons
Instruments for equation 2: _cons
Instruments for equation 3: _cons
Instruments for equation 4: _cons
```

```
. estat overid

  Test of overidentifying restriction:

  Hansen's J chi2(3) = 4.59432 (p = 0.2040)

. estimates store dot

. gmm (dr-{beta}*r) ((dr-{beta}*r)*r) ((dr-{beta}*r)^2-{sigma2}*r^2) (((dr-{beta}*r)^2-{sigma2}*r^2)*r) winitial(identity)
note: 1 missing value returned for equation 1 at initial values
note: 1 missing value returned for equation 2 at initial values
note: 1 missing value returned for equation 3 at initial values
note: 1 missing value returned for equation 4 at initial values
```

· GBM

```
Step 1
Iteration 0:   GMM criterion Q(b) =  .00001173
Iteration 1:   GMM criterion Q(b) =  8.547e-08
Iteration 2:   GMM criterion Q(b) =  8.547e-08

Step 2
Iteration 0:   GMM criterion Q(b) =   .0082543
Iteration 1:   GMM criterion Q(b) =  .00342544
Iteration 2:   GMM criterion Q(b) =  .00342542

GMM estimation

Number of parameters =   2
Number of moments    =   4
Initial weight matrix: Identity                 Number of obs   =      1,334
GMM weight matrix:     Robust
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf. Interval]	
/beta	.0000248	.0001265	0.20	0.844	-.000223	.0002727
/sigma2	.0000154	8.33e-06	1.84	0.065	-9.60e-07	.0000317

```
Instruments for equation 1: _cons
Instruments for equation 2: _cons
Instruments for equation 3: _cons
Instruments for equation 4: _cons
```

```
. estat overid

  Test of overidentifying restriction:

  Hansen's J chi2(2) = 4.56951 (p = 0.1018)

. estimates store gbm

. gmm (dr-{alpha}-{beta}*r) ((dr-{alpha}-{beta}*r)*r) ((dr-{alpha}-{beta}*r)^2-{sigma2}*r^2) (((dr-{alpha}-{beta}*r)^2-{sigma2}*r^2)*r) winitial(identity)
note: 1 missing value returned for equation 1 at initial values
note: 1 missing value returned for equation 2 at initial values
note: 1 missing value returned for equation 3 at initial values
note: 1 missing value returned for equation 4 at initial values

Step 1
Iteration 0:   GMM criterion Q(b) =  .00001173
Iteration 1:   GMM criterion Q(b) =  1.062e-08
Iteration 2:   GMM criterion Q(b) =  1.061e-08

Step 2
Iteration 0:   GMM criterion Q(b) =   .0202404
Iteration 1:   GMM criterion Q(b) =  .00259237
Iteration 2:   GMM criterion Q(b) =  .00259234

GMM estimation

Number of parameters =   3
Number of moments    =   4
Initial weight matrix: Identity                 Number of obs   =      1,334
GMM weight matrix:     Robust
```

• Brennan & Schwartz

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
/alpha	-.0008979	.0008413	-1.07	0.286	-.0025469	.000751
/beta	.0002882	.0002774	1.04	0.299	-.0002555	.0008319
/sigma2	8.91e-06	.0000103	0.87	0.387	-.0000113	.0000291

```
Instruments for equation 1: _cons
Instruments for equation 2: _cons
Instruments for equation 3: _cons
Instruments for equation 4: _cons
```

```
. estat overid

  Test of overidentifying restriction:

  Hansen's J chi2(1) = 3.45819 (p = 0.0629)

. estimates store bren

. gmm (dr) (dr*r) (dr^2-{sigma2}*r^3) ((dr^2-{sigma2}*r^3)*r) winitial(identity)
note: no parameters in equation 1
note: no parameters in equation 2
note: 1 missing value returned for equation 1 at initial values
note: 1 missing value returned for equation 2 at initial values
note: 1 missing value returned for equation 3 at initial values
note: 1 missing value returned for equation 4 at initial values

Step 1
Iteration 0:   GMM criterion Q(b) =  .00001173
Iteration 1:   GMM criterion Q(b) =  5.694e-06
Iteration 2:   GMM criterion Q(b) =  5.694e-06

Step 2
Iteration 0:   GMM criterion Q(b) =  .01561186
Iteration 1:   GMM criterion Q(b) =   .0038055
Iteration 2:   GMM criterion Q(b) =   .0038055

GMM estimation

Number of parameters =   1
Number of moments    =   4
Initial weight matrix: Identity                 Number of obs   =      1,334
GMM weight matrix:     Robust
```

• CIR VR

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
/sigma2	2.70e-06	1.26e-06	2.15	0.032	2.35e-07	5.16e-06

```
Instruments for equation 1: _cons
Instruments for equation 2: _cons
Instruments for equation 3: _cons
Instruments for equation 4: _cons
```

```
. estat overid

  Test of overidentifying restriction:

  Hansen's J chi2(3) = 5.07654 (p = 0.1663)

. estimates store cir_vr

. gmm (dr-{beta}*r) ((dr-{beta}*r)*r) ((dr-{beta}*r)^2-{sigma2}*r^(2*{gamma})) (((dr-{beta}*r)^2-{sigma2}*r^(2*{gamma}))*r) winitial(identity)
note: 1 missing value returned for equation 1 at initial values
note: 1 missing value returned for equation 2 at initial values
note: 1 missing value returned for equation 3 at initial values
note: 1 missing value returned for equation 4 at initial values

Step 1
numerical derivatives are approximate
flat or discontinuous region encountered
Iteration 0:   GMM criterion Q(b) =  .00001173
Iteration 1:   GMM criterion Q(b) =  8.627e-06  (backed up)
Iteration 2:   GMM criterion Q(b) =  6.127e-06  (not concave)
Iteration 3:   GMM criterion Q(b) =  5.400e-06  (backed up)
Iteration 4:   GMM criterion Q(b) =  5.310e-06

Step 2
Iteration 0:   GMM criterion Q(b) =  .01236133
Iteration 1:   GMM criterion Q(b) =  .01075751
Iteration 2:   GMM criterion Q(b) =  .00760436
Iteration 3:   GMM criterion Q(b) =  .00678694
Iteration 4:   GMM criterion Q(b) =  .00326882
Iteration 5:   GMM criterion Q(b) =  .00316225
Iteration 6:   GMM criterion Q(b) =  .00313882
Iteration 7:   GMM criterion Q(b) =   .0031388

GMM estimation

Number of parameters =   3
Number of moments    =   4
Initial weight matrix: Identity                 Number of obs   =      1,334
GMM weight matrix:     Robust
```

• CEV

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
/beta	-.0000453	.0001702	-0.27	0.790	-.0003789	.0002883
/sigma2	.0000881	.0001436	0.61	0.539	-.0001933	.0003696
/gamma	.5717551	.3668112	1.56	0.119	-.1471817	1.290692

```
Instruments for equation 1: _cons
Instruments for equation 2: _cons
Instruments for equation 3: _cons
Instruments for equation 4: _cons
```

```
. estat overid

  Test of overidentifying restriction:

  Hansen's J chi2(1) = 4.18715 (p = 0.0407)
```

< 0.05

```
. estimates store cev

. est table unres merton vas cir_sr dot gbm bren cir_vr cev, star(0.1 0.05 0.01)
```

Variable	unres	merton	vas	cir_sr	dot	gbm	bren	cir_vr	cev
alpha									
_cons	-.00237253**	-.00081372	-.00269937***	-.00102525			-.00089794		
beta									
_cons	.00042912		.00053681***	.00022877		.00002483	.0002882		-.00004534
sigma2									
_cons	.00050427	.00042766	.00058872**	.00009168	.00001618**	.00001536*	8.909e-06	2.698e-06**	.00008815
gamma									
_cons	.09851773								.57175507

legend: * p<.1; ** p<.05; *** p<.01

```
.
end of do-file
```

(b)

```
. gmm (dr-{alpha}-{beta}*r) ((dr-{alpha}-{beta}*r)*r) ((dr-{alpha}-{beta}*r)^2-{sigma2}*r^(2*{gamma})) (((dr-{alpha}-{beta}*r)^2-{sigma2}*r^(2*{gamma}))*r) winitia
note: 1 missing value returned for equation 1 at initial values
note: 1 missing value returned for equation 2 at initial values
note: 1 missing value returned for equation 3 at initial values
note: 1 missing value returned for equation 4 at initial values

Step 1
numerical derivatives are approximate
flat or discontinuous region encountered
Iteration 0:   GMM criterion Q(b) =  .00001173
Iteration 1:   GMM criterion Q(b) =  8.321e-06  (backed up)
Iteration 2:   GMM criterion Q(b) =  6.043e-06  (not concave)
Iteration 3:   GMM criterion Q(b) =  1.604e-06
Iteration 4:   GMM criterion Q(b) =  1.662e-09
Iteration 5:   GMM criterion Q(b) =  1.344e-13

Step 2
Iteration 0:   GMM criterion Q(b) =  3.899e-10
Iteration 1:   GMM criterion Q(b) =  4.098e-18

note: model is exactly identified

GMM estimation
```

```
Number of parameters =   4
Number of moments    =   4
Initial weight matrix: Identity                  Number of obs   =      1,334
GMM weight matrix:     Robust
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf. Interval]	
/alpha	-.0023725	.0011574	-2.05	0.040	-.0046409	-.0001041
/beta	.0004291	.0002873	1.49	0.135	-.000134	.0009922
/sigma2	.0005043	.000324	1.56	0.120	-.0001307	.0011393
/gamma	.0985177	.1823933	0.54	0.589	-.2589666	.456002

```
Instruments for equation 1: _cons
Instruments for equation 2: _cons
Instruments for equation 3: _cons
Instruments for equation 4: _cons

. test (_b[/beta]=0) (_b[/gamma]=0)

 ( 1)  [beta]_cons = 0
 ( 2)  [gamma]_cons = 0

           chi2(  2) =    7.92
         Prob > chi2 =    0.0191

. test (_b[/gamma]=0)

 ( 1)  [gamma]_cons = 0

           chi2(  1) =    0.29
         Prob > chi2 =    0.5891
```

Vasicek

```
. test (_b[/gamma]=0.5)

 ( 1)  [gamma]_cons = .5

           chi2(  1) =    4.85
         Prob > chi2 =    0.0277

. test (_b[/alpha]=0) (_b[/beta]=0) (_b[/gamma]=1)

 ( 1)  [alpha]_cons = 0
 ( 2)  [beta]_cons = 0
 ( 3)  [gamma]_cons = 1

           chi2(  3) =   34.04
         Prob > chi2 =    0.0000
```

```
. test (_b[/alpha]=0) (_b[/gamma]=1)

 ( 1)  [alpha]_cons = 0
 ( 2)  [gamma]_cons = 1

           chi2(  2) =   27.48
         Prob > chi2 =    0.0000

. test (_b[/gamma]=1)

 ( 1)  [gamma]_cons = 1

           chi2(  1) =   24.43
         Prob > chi2 =    0.0000

. test (_b[/alpha]=0) (_b[/beta]=0) (_b[/gamma]=1.5)

 ( 1)  [alpha]_cons = 0
 ( 2)  [beta]_cons = 0
 ( 3)  [gamma]_cons = 1.5

           chi2(  3) =   95.71
         Prob > chi2 =    0.0000

. test (_b[/alpha]=0)

 ( 1)  [alpha]_cons = 0

           chi2(  1) =    4.20
         Prob > chi2 =    0.0404

.
```

Assignment 5

1. In the study of interest rate structure, the continuous time model can be specified as:

$$r_{t+\Delta t} - r_t = (\alpha + \beta r_t)\Delta t + \varepsilon_{t+\Delta t} \quad (1)$$

where: $E[\varepsilon_{t+\Delta t}] = 0$ and $E[\varepsilon_{t+\Delta t}^2] = \sigma^2 r_t^{2\gamma} \Delta t$

Then, the model can be transformed to be discrete time model by setting $\Delta t = 1$. The discrete time model can be stated as:

$$r_{t+1} - r_t = \Delta r_t = \alpha + \beta r_t + \varepsilon_{t+1} \quad (2)$$

where: $E[\varepsilon_{t+1}] = 0$ and $E[\varepsilon_{t+1}^2] = \sigma^2 r_t^{2\gamma}$

The above model consists of four parameters including $\alpha, \beta, \sigma^2, \gamma$. The model can be estimate using GMM. Four moment condition equations can be stated as:

Zero mean condition: $E(\varepsilon_{t+1}) = 0$

Orthogonality condition: $E(\varepsilon_{t+1} r_t) = 0$

Variance condition: $E(\varepsilon_{t+1}^2 - \sigma^2 r_t^{2\gamma}) = 0$

Zero covariance condition: $E\left(\left(\varepsilon_{t+1}^2 - \sigma^2 r_t^{2\gamma}\right) r_t\right) = 0$

The above model can be claimed as unrestricted model for other eight interest rate structure models which can be indicated as follows:

Model	α	β	σ^2	γ
(1) Unrestricted				
(2) Merton		0		0
(3) Vasicek				0
(4) CIR SR				0.5
(5) Dothan	0	0		1
(6) GBM	0			1
(7) Brennan & Schwartz				1
(8) CIR VR	0	0		1.5
(9) CEV	0			

From the given data set (`assign5-1.dta`):

a. Estimate the interest rate structure models applying all 9 models using GMM. Also perform Overidentification Test. (Hint: command for generating $\Delta r_t = r_{t+1} - r_t$ is `gen dr=f.r-r`)

After running and performing the overidentification test, at 5% level, the results shows that only Merton and CEV models, some of whose moment conditions are not true (The Hansen's J χ^2 statistics fall into rejection region)

b. Determine the most appropriated model using Wald Test.

According to the Wald Test, Vasicek Model is the most appropiate one because it has the largest P-value. It means that its null hypothesis is very strong (cannot be rejected)

2. From the model:

$$y_i = \alpha + \beta x_i + u_i \qquad (3)$$

where: y_i is dependent variable

x_i is explanatory variable

u_i is stochastic error term

$E(u_i) = 0$ but $E(x_i u_i) \neq 0$.

From the given data set (`assign5-2.dta`):

a. Estimate model (3) using OLS.
b. Based on z_1, z_2, z_3, z_4, determine the best set of instrumental variables, then, estimate model (3) using GMM.
c. Determine whether OLS estimated results in (a) or GMM estimated results in (b) is more appropriate using the Hansen's J chi2 statistic test.

```
                                                      ___  ____  ____  ____  ____(R)
                                                     /__    /   ____/   /   ____/
                                                    ___/   /   /___/   /   /___/
                                                      Statistics/Data Analysis

  ___  ____  ____  ____  ____ (R)
 /__    /   ____/   /   ____/
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Notes:
      1.  Unicode is supported; see help unicode advice.
      2.  More than 2 billion observations are allowed; see help obs advice.
      3.  Maximum number of variables is set to 5000; see help set maxvar.

  1 . use "C:\Users\Chaiyapong M\Desktop\BE\EE426\Assignment 5\assign5-2.dta", clear
```

(2)

```
  2 . reg y x

      Source |       SS           df       MS      Number of obs   =       500
-------------+----------------------------------   F(1, 498)       =    449.66
       Model |  132481.702         1  132481.702   Prob > F        =    0.0000
    Residual |  146722.774       498  294.624043   R-squared       =    0.4745
-------------+----------------------------------   Adj R-squared   =    0.4734
       Total |  279204.475       499  559.528007   Root MSE        =    17.165
```

y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
x	**5.431333**	**.2561312**	**21.21**	**0.000**	**4.928102**	**5.934564**
_cons	**-33.31333**	**2.673868**	**-12.46**	**0.000**	**-38.56678**	**-28.05988**

(b) + (c)

```
3 . corr y x z1 z2 z3 z4
(obs=500)
```

	y	x	z1	z2	z3	z4
y	**1.0000**					
x	**0.6888**	**1.0000**				
z1	**0.2002**	**0.7215**	**1.0000**			
z2	**0.1203**	**0.2352**	**0.1937**	**1.0000**		
z3	**0.9214**	**0.5487**	**0.0918**	**0.0933**	**1.0000**	
z4	**0.1887**	**0.6954**	**0.4738**	**0.1607**	**0.0828**	**1.0000**

```
4 . ivregress gmm y (x= z1 z4)

Instrumental variables (GMM) regression           Number of obs   =        500
                                                  Wald chi2(1)    =      40.88
                                                  Prob > chi2     =     0.0000
                                                  R-squared       =     0.3031
GMM weight matrix: Robust                         Root MSE        =     19.727
```

y	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
x	**2.167043**	**.3389432**	**6.39**	**0.000**	**1.502726**	**2.831359**
_cons	**-.6716121**	**3.395567**	**-0.20**	**0.843**	**-7.326801**	**5.983577**

Instrumented: x
Instruments: z1 z4

```
5 . estat overid

    Test of overidentifying restriction:

    Hansen's J chi2(1) = .012951 (p = 0.9094)

6 . estat endogenous x

    Test of endogeneity (orthogonality conditions)
    Ho: variables are exogenous

    GMM C statistic chi2(1) =  157.747  (p = 0.0000)

7 . quietly ivregress gmm y (x= z1 z2)
```

```
 8 . estat overid

     Test of overidentifying restriction:

     Hansen's J chi2(1) = 2.55533 (p = 0.1099)

 9 . quietly ivregress gmm y (x= z1 z3)

10 . estat overid

     Test of overidentifying restriction:

     Hansen's J chi2(1) = 159.838 (p = 0.0000)

11 . quietly ivregress gmm y (x= z2 z3)

12 . estat overid

     Test of overidentifying restriction:

     Hansen's J chi2(1) = 24.2483 (p = 0.0000)

13 . quietly ivregress gmm y (x= z2 z4)
```

```
14 . estat overid

     Test of overidentifying restriction:

     Hansen's J chi2(1) = 2.47701 (p = 0.1155)

15 . quietly ivregress gmm y (x= z3 z4)

16 . estat overid

     Test of overidentifying restriction:

     Hansen's J chi2(1) = 148.756 (p = 0.0000)

17 .
```

2. From the model:

$$y_i = \alpha + \beta x_i + u_i \qquad (3)$$

where: y_i is dependent variable

x_i is explanatory variable

u_i is stochastic error term

$E(u_i) = 0$ but $E(x_i u_i) \neq 0$.

From the given data set (`assign5-2.dta`):

a. Estimate model (3) using OLS.

Using OLS, the estimated result is ...

$$\hat{y} = -33.31 + 5.43X$$
$$(2.67) \qquad (0.26)$$

$N = 500$

$R^2 = 0.4745$

Adj - $R^2 = 0.4734$

b. Based on z_1, z_2, z_3, z_4, determine the best set of instrumental variables, then, estimate model (3) using GMM.

Firstly, I look at the correlation among those variables because good intrument variables should have high correlation with x (the endogenous variable)

```
3 . corr y x z1 z2 z3 z4
(obs=500)
```

	y	x	z1	z2	z3	z4
y	1.0000					
x	0.6888	1.0000				
z1	0.2002	0.7215	1.0000			
z2	0.1203	0.2352	0.1937	1.0000		
z3	0.9214	0.5487	0.0918	0.0933	1.0000	
z4	0.1887	0.6954	0.4738	0.1607	0.0828	1.0000

the result suggests that z_1 and z_4 should be used.

So, I use z_1 and z_4 as intrumental variables, and run the model using GMM.

```
4 . ivregress gmm y (x= z1 z4)

Instrumental variables (GMM) regression          Number of obs   =        500
                                                 Wald chi2(1)    =      40.88
                                                 Prob > chi2     =     0.0000
                                                 R-squared       =     0.3031
GMM weight matrix: Robust                        Root MSE        =     19.727

------------------------------------------------------------------------------
             |               Robust
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   2.167043   .3389432     6.39   0.000     1.502726    2.831359
       _cons |  -.6716121   3.395567    -0.20   0.843    -7.326801    5.983577
------------------------------------------------------------------------------
Instrumented:  x
Instruments:   z1 z4

5 . estat overid

  Test of overidentifying restriction:

  Hansen's J chi2(1) = .012951 (p = 0.9094)

6 . estat endogenous x

  Test of endogeneity (orthogonality conditions)
  Ho: variables are exogenous

  GMM C statistic chi2(1) =  157.747  (p = 0.0000)
```

The estimated model is

$$\hat{y} = -0.6716 + 2.16X$$
$$(3.40) \qquad (0.34)$$

Moreover, the overidentification test reveals the very high p-value (and highest among any other pairs of IV). Thus, it can be concluded that z_1 and z_4 is the best set of instrumental variables.

c. Determine whether OLS estimated results in (a) or GMM estimated results in (b) is more appropriate using the Hansen's J chi2 statistic test.

GMM estimated result is more appropriate compared with those of OLS because there exists endogeneity problem causing the bias results under OLS. Using GMM with z_1 and z_4 as intrumental variables is better. According to the Hansen's J chi2 test or overidentification test, it claims that all moment conditions are true.

That is why I answer that GMM estimated result is belter.