Assignment 3

From the data set `assign3.dta`:

The study of production function assumes the model follows CES production function:

$$y = \gamma\left[\delta K^{-\rho} + (1-\delta)L^{-\rho}\right]^{-\frac{\nu}{\rho}} + \varepsilon \qquad (1)$$

where:

y = Output
K = Capital Input
L = Labor Input
γ = Efficiency Parameter
δ = Distribution Parameter
ν = Parameter
ρ = Substitution Parameter
ε = Disturbance Term

Elasticity of Substitution can be computed from: $\sigma = \dfrac{1}{1-\rho}$

The model can then be transformed as:

$$\ln y = \ln\gamma - \frac{\nu}{\rho}\ln\left[\delta K^{-\rho} + (1-\delta)L^{-\rho}\right] + \varepsilon \qquad (2)$$

a. Estimate the model (1) using NLS estimation method using initial values of γ=4, δ=0, ρ= –1, ν=1. Determine the estimated value of efficiency parameter (γ), distribution parameter (δ), parameter (ν), and substitution parameter (ρ), and elasticity of substitution (σ). Perform F-test to test whether δ=0, ρ=0, and ν=0.

b. Estimate the model (2) using NLS estimation method initial values of lnγ=4, δ=0, ρ= –1, ν=1. Determine the estimated value of efficiency parameter (γ), distribution parameter (δ), parameter (ν), and substitution parameter (ρ), and elasticity of substitution (σ). Perform F-test to test whether δ=0, ρ=0, and ν=0.

c. From (a), if we change initial values to be γ=55, δ=0, ρ= –1, ν=1, what will happen to the estimated result? Interpret the estimated result and why do we get this kind of result? (Make comparison between previous result and the new result)

d. From (a), if we change convergence value from default of 0.00001 or (1e-5) to (i) 0.1 or (1e-1) and (ii) (1e-15) with maximum iteration of 100, what will happen to the estimated result? Interpret the estimated result and why do we get this kind of result? (Make comparison between previous result and the new result)

e. From (b), if we change initial values to be lnγ=55, δ=0, ρ= –1, ν=1, what will happen to the estimated result? Interpret the estimated result and why do we get this kind of result? (Make comparison between previous result and the new result)

f. From (b), if we change convergence value from default of 0.00001 or (1e-5) to (i) 0.1 or (1e-1) and (ii) (1e-15) with maximum iteration of 100, what will happen to

the estimated result? Interpret the estimated result and why do we get this kind of result? (Make comparison between previous result and the new result)

g. Make comparison of the estimated results of model (1) and model (2). Which estimated result should be used in this case? Why?

a. Estimate the model (1) using NLS estimation method using initial values of γ=4, δ=0, ρ= –1, ν=1. Determine the estimated value of efficiency parameter (γ), distribution parameter (δ), parameter (ν), and substitution parameter (ρ), and elasticity of substitution (σ). Perform F-test to test whether δ=0, ρ=0, and ν=0.

Source	SS	df	MS		
Model	2.363e+20	4	5.9080e+19	Number of obs	800
Residual	9.271e+18	796	1.1647e+16	R-squared	0.9622
				Adj R-squared	0.9621
Total	2.456e+20	800	3.0699e+17	Root MSE	1.08e+08
				Res. dev.	31861.36

y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/gamma	2.89e-17	6.45e-17	0.45	0.654	-9.77e-17	1.55e-16
/delta	.8017609	.0319332	25.11	0.000	.7390776	.8644442
/rho	-1.88296	.2889715	-6.52	0.000	-2.450196	-1.315724
/nu	3.39589	.1261608	26.92	0.000	3.148243	3.643538

```
. test (_b[/delta] = 0) (_b[/rho] = 0) (_b[/nu] = 0)

 ( 1)  [delta]_cons = 0
 ( 2)  [rho]_cons = 0
 ( 3)  [nu]_cons = 0

       F(  3,    796) = 7383.35
            Prob > F =    0.0000
```

∴ Reject H_0, $\delta=0$, $\rho=0$, and $\nu=0$ is not true.

b. Estimate the model (2) using NLS estimation method initial values of lnγ=4, δ=0, ρ= –1, ν=1. Determine the estimated value of efficiency parameter (γ), distribution parameter (δ), parameter (ν), and substitution parameter (ρ), and elasticity of substitution (σ). Perform F-test to test whether δ=0, ρ=0, and ν=0.

```
. use "C:\Users\User\Desktop\426\assign3.dta", clear

. nl (lny = ({ln(gamma)})-({nu}/{rho})*ln(({delta}*(k^-{rho}))+((1-{delta})*(l^-{rho})))),init(ln(gamma)
(obs = 800)

Iteration 0:  residual SS =    1143.768
Iteration 1:  residual SS =     1141.42
Iteration 2:  residual SS =    1079.493
Iteration 3:  residual SS =    1057.679
Iteration 4:  residual SS =    1020.318
Iteration 5:  residual SS =    984.4116
Iteration 6:  residual SS =    877.3659
Iteration 7:  residual SS =    835.1387
Iteration 8:  residual SS =    824.3481
Iteration 9:  residual SS =    820.0827
Iteration 10:  residual SS =    819.9925
Iteration 11:  residual SS =    819.9925
Iteration 12:  residual SS =    819.9925
Iteration 13:  residual SS =    819.9925
Iteration 14:  residual SS =    819.9925
Iteration 15:  residual SS =    819.9925
```

Source	SS	df	MS		
Model	976.20485	3	325.401616	Number of obs	800
Residual	819.99246	796	1.03014129	R-squared	0.5435
				Adj R-squared	0.5418
Total	1796.1973	799	2.24805671	Root MSE	1.014959
				Res. dev.	2290.048

lny	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/ln(gamma)	3.7988	.4234183	8.97	0.000	2.967652	4.629948
/nu	.9727292	.0317774	30.61	0.000	.9103518	1.035107
/rho	-.8079851	.2186213	-3.70	0.000	-1.237128	-.3788427
/delta	.2351023	.0328462	7.16	0.000	.1706268	.2995778

Parameter ln(gamma) taken as constant term in model & ANOVA table

```
. test (_b[/delta] = 0) (_b[/rho] = 0) (_b[/nu] = 0)

 ( 1)  [delta]_cons = 0
 ( 2)  [rho]_cons = 0
 ( 3)  [nu]_cons = 0

       F(  3,    796) =    366.55
            Prob > F =    0.0000
```

Reject H_0, H_0 is not true.

c. From (a), if we change initial values to be γ=55, δ=0, ρ= –1, ν=1, what will happen to the estimated result? Interpret the estimated result and why do we get this kind of result? (Make comparison between previous result and the new result)

Source	SS	df	MS		
Model	1.105e+20	4	2.7613e+19	Number of obs =	800
Residual	1.351e+20	796	1.6977e+17	R-squared =	0.4497
				Adj R-squared =	0.4470
Total	2.456e+20	800	3.0699e+17	Root MSE =	4.12e+08
				Res. dev. =	34004.88

y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/gamma	15.24071	9.37733	1.63	0.105	-3.166506	33.64793
/delta	.0549096	2.023112	0.03	0.978	-3.916356	4.026175
/rho	-38.85704	533.7257	-0.07	0.942	-1086.533	1008.819
/nu	1.063501	.0348929	30.48	0.000	.9950082	1.131994

After the initial value of Y change, the estimated parameters have become insignificant at 10% level. This is because we change the initial value of the gamma parameter which might cause the parameter to be inappropriate to the model.

d. From (a), if we change convergence value from default of 0.00001 or (1e-5) to (i) 0.1 or (1e-1) and (ii) (1e-15) with maximum iteration of 100, what will happen to the estimated result? Interpret the estimated result and why do we get this kind of result? (Make comparison between previous result and the new result)

```
. nl ( y = ({gamma}*((({delta}*(k^-{rho}))+((1-{delta})*l^-{rho}))^(-{nu}/{rho})))),init(gam
> ma 4 delta 0 rho -1 nu 1) eps(0.1)
(obs = 800)

Iteration 0:  residual SS =    2.35e+20
Iteration 1:  residual SS =    2.35e+20
```

Source	SS	df	MS		
Model	1.043e+19	4	2.6070e+18	Number of obs =	800
Residual	2.352e+20	796	2.9543e+17	R-squared =	0.0425
				Adj R-squared =	0.0376
Total	2.456e+20	800	3.0699e+17	Root MSE =	5.44e+08
				Res. dev. =	34448.06

y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/gamma	4.000008	15.19032	0.26	0.792	-25.8178	33.81782
/delta	1.29e-07	.0001605	0.00	0.999	-.0003149	.0003152
/rho	-29.02157	2409.787	-0.01	0.990	-4759.309	4701.266
/nu	1	.2149768	4.65	0.000	.5780116	1.421988

These model in both (i) and (ii) have multiple insignificant parameters compare to the original one in (a).

This problem could come from the inappropriate convergence value in (i) that is too large and in (ii) that is too small.

eps (1e-15)

Source	SS	df	MS		
Model	1.044e+19	4	2.6110e+18	Number of obs =	800
Residual	2.351e+20	796	2.9541e+17	R-squared =	0.0425
				Adj R-squared =	0.0377
Total	2.456e+20	800	3.0699e+17	Root MSE =	5.44e+08
				Res. dev. =	34448.01

y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/gamma	4.002498	14.72681	0.27	0.786	-24.90547	32.91047
/delta	.0000248	.0071879	0.00	0.997	-.0140847	.0141342
/rho	-19.15877	594.8618	-0.03	0.974	-1186.842	1148.524
/nu	.9999955	.20826	4.80	0.000	.5911918	1.408799

```
convergence not achieved
r(430);
```

e. From (b), if we change initial values to be lnγ=55, δ=0, ρ= –1, ν=1, what will happen to the estimated result? Interpret the estimated result and why do we get this kind of result? (Make comparison between previous result and the new result)

```
. nl (lny = ({ln(gamma)})-({nu}/{rho})*ln(({delta}*(k^-{rho}))+((1-{delta})*(l^-{rho})))),init(ln(gamma)
(obs = 800)

Iteration 0:  residual SS =     2124801
Iteration 1:  residual SS =     2060592
Iteration 2:  residual SS =     1887054
Iteration 3:  residual SS =     1583318
Iteration 4:  residual SS =     1449254
Iteration 5:  residual SS =    2710.679
Iteration 6:  residual SS =    921.5861
Iteration 7:  residual SS =    898.0845
Iteration 8:  residual SS =    860.9171
Iteration 9:  residual SS =    828.7014
Iteration 10:  residual SS =    820.0705
Iteration 11:  residual SS =    819.9927
Iteration 12:  residual SS =    819.9925
Iteration 13:  residual SS =    819.9925
Iteration 14:  residual SS =    819.9925
Iteration 15:  residual SS =    819.9925
Iteration 16:  residual SS =    819.9925
Iteration 17:  residual SS =    819.9925
```

Source	SS	df	MS		
Model	976.20485	3	325.401616	Number of obs =	800
Residual	819.99246	796	1.03014129	R-squared =	0.5435
				Adj R-squared =	0.5418
Total	1796.1973	799	2.24805671	Root MSE =	1.014959
				Res. dev. =	2290.048

lny	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/ln(gamma)	3.7988	.4234183	8.97	0.000	2.967652	4.629949
/nu	.9727292	.0317774	30.61	0.000	.9103518	1.035107
/rho	-.8079831	.2186234	-3.70	0.000	-1.23713	-.3788367
/delta	.2351025	.0328464	7.16	0.000	.1706267	.2995783

Parameter ln(gamma) taken as constant term in model & ANOVA table

The coefficient of the model in (b) and this model are almost identical. This implys that the initial value for gamma of either 55 or 4 are appropriate in this model, since the coefficient of the parameters are significant at 5% level.

f. From (b), if we change convergence value from default of 0.00001 or (1e-5) to (i) 0.1 or (1e-1) and (ii) (1e-15) with maximum iteration of 100, what will happen to the estimated result? Interpret the estimated result and why do we get this kind of result? (Make comparison between previous result and the new result)

eps(1-e5)

```
. nl (lny = ({ln(gamma)})-({nu}/{rho})*ln(({delta}*(k^-{rho}))+((1-{delta})*(l^-{rho})))),init(ln(gamma)
(obs = 800)

Iteration 0:  residual SS =    1143.768
Iteration 1:  residual SS =     1141.42
Iteration 2:  residual SS =    1079.493
Iteration 3:  residual SS =    1057.679
Iteration 4:  residual SS =    1020.318
Iteration 5:  residual SS =    984.4116
Iteration 6:  residual SS =    877.3659
Iteration 7:  residual SS =    835.1387
Iteration 8:  residual SS =    824.3481
Iteration 9:  residual SS =    820.0827
Iteration 10:  residual SS =    819.9925
```

Source	SS	df	MS		
Model	976.20481	3	325.401605	Number of obs =	800
Residual	819.9925	796	1.03014133	R-squared =	0.5435
				Adj R-squared =	0.5418
Total	1796.1973	799	2.24805671	Root MSE =	1.014959
				Res. dev. =	2290.048

lny	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/ln(gamma)	3.799136	.4234428	8.97	0.000	2.96794	4.630333
/nu	.9727141	.0317771	30.61	0.000	.9103373	1.035091
/rho	-.8069885	.2188083	-3.69	0.000	-1.236498	-.3774791
/delta	.2352397	.0329504	7.14	0.000	.1705598	.2999197

Parameter nu taken as constant term in model & ANOVA table

eps (1e-15)

```
. nl (lny = ({ln(gamma)})-({nu}/{rho})*ln(({delta}*(k^-{rho}))+((1-{delta})*(l^-{rho})))),init(ln(gamma)
(obs = 800)

Iteration 0:  residual SS =    1143.768
Iteration 1:  residual SS =     1141.42
Iteration 2:  residual SS =    1079.493
Iteration 3:  residual SS =    1057.679
Iteration 4:  residual SS =    1020.318
Iteration 5:  residual SS =    984.4116
Iteration 6:  residual SS =    877.3659
Iteration 7:  residual SS =    835.1387
Iteration 8:  residual SS =    824.3481
Iteration 9:  residual SS =    820.0827
Iteration 10:  residual SS =    819.9925
Iteration 11:  residual SS =    819.9925
Iteration 12:  residual SS =    819.9925
Iteration 13:  residual SS =    819.9925
Iteration 14:  residual SS =    819.9925
Iteration 15:  residual SS =    819.9925
Iteration 16:  residual SS =    819.9925
Iteration 17:  residual SS =    819.9925
Iteration 18:  residual SS =    819.9925
Iteration 19:  residual SS =    819.9925
Iteration 20:  residual SS =    819.9925
Iteration 21:  residual SS =    819.9925
Iteration 22:  residual SS =    819.9925
Iteration 23:  residual SS =    819.9925
Iteration 24:  residual SS =    819.9925
Iteration 25:  residual SS =    819.9925
Iteration 26:  residual SS =    819.9925
Iteration 27:  residual SS =    819.9925
Iteration 28:  residual SS =    819.9925
Iteration 29:  residual SS =    819.9925
```

Source	SS	df	MS		
Model	222930.73	4	55732.6813	Number of obs =	800
Residual	819.99246	796	1.03014129	R-squared =	0.9963
				Adj R-squared =	0.9963
Total	223750.72	800	279.688397	Root MSE =	1.014959
				Res. dev. =	2290.048

lny	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/ln(gamma)	3.7988	.4234183	8.97	0.000	2.967652	4.629949
/nu	.9727292	.0317774	30.61	0.000	.9103518	1.035107
/rho	-.8079839	.2186225	-3.70	0.000	-1.237129	-.3788392
/delta	.2351024	.0328463	7.16	0.000	.1706267	.2995781

.

The value of the coefficients change by a little bit in both from (b) in both (i) and (ii). However, in (ii) the r^2 increases to 0.9963, this might come from the reason that the convergence value that was set is small, which make the $\hat{\theta}$ value converge closer to 0.

g. Make comparison of the estimated results of model (1) and model (2). Which estimated result should be used in this case? Why?

Model (2) but with the condition that it must be regressed with the convergence value of (1e-15). This because the r^2 in this model is higher model (1), and also all the parameter are significant.