

## รายการอ้างอิง

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## ภาคผนวก

### ภาคผนวก ก วิธีการหาคำตอบเชิงจำนวนของวิธี Double Pool, Variable-Extracellular Volume Urea Kinetic Model

Variables:

- $V_E$  = extracellular compartment volume (ml)  
 $V_I$  = intracellular compartment volume (ml)  
 $C_E$  = extracellular urea nitrogen concentration (mg/ml)  
 $C_I$  = intracellular urea nitrogen concentration (mg/ml)  
 $G$  = urea nitrogen generation rate (mg/ml)  
 $K_{cu}$  = intercompartment mass transfer coefficient (ml/min)  
 $K$  = dialyzer urea clearance (ml/min)  
 $t$  = time (min)  
 $Q_f$  = rate of weight gain during or between dialysis (ml/min)  
 $dt$  = small interval of time (min)

Initially, when  $t = 0$ :

$$\begin{aligned}C_{E0} &= C_E(t) \\C_{I0} &= C_I(t) \\V_{E0} &= V_E(t)\end{aligned}$$

Equation of double pool UKM:

$$\frac{dC_E * V_E}{dt} = \frac{V_E dC_E}{dt} + \frac{C_E dV_E}{dt} = G - K_{cu}(C_E - C_I) - C_E K \quad D1$$

$$\frac{C_E dV_E}{dt} = Q_f \quad (Q_f \text{ is negative during dialysis}) \quad D2$$

Integrate D2:

$$V_E = V_{E0} + Q_f t \quad D3$$

$$\frac{V_I dC_I}{dt} = K_{cu}(C_E - C_I) \quad D4$$

Discrete solution of equation D1:

$$C_E(t+dt) = C_E t + dt [G - K_{cu} C_E(t) - C_I(t)] / (Q_f t + V_{E0}) - C_E(t) K - C_E(t) Q_f \quad D5$$

Discrete solution of equation D4:

$$C_I(t+dt) = C_I t + dt [K_{cu} C_E(t) - C_I(t)] / V_I \quad D6$$

Following is a description of the algorithm for calculating V and G described in appendix 2:

To solve for  $C_E$  and  $C_I$  at the end of dialysis:

Divide total dialysis time into a selected number of time intervals (n)

Divide total dialysis time (n) to obtain a discrete value for dt

Solve equation D5 for t=0 conditions

Solve equation D6 for t=0 conditions

Replace  $C_E(t)$  and  $C_I(t)$  with new values for  $C_E$  and  $C_I$  respectively

Loop through solutions of equations D5 and D6 (n) times

$C_E$  should match the measured post dialysis BUN

If  $C_E$  does not match, adjust  $V_E$  and  $V_I$  and begin again.

This establishes V.

To solve for  $C_E$  and  $C_I$  at the end of a week of dialysis:

Select the next interdialysis interval

Divide this total time into discrete small (n) intervals as above

Change  $Q_f$  to reflect rate of weight gain between dialysis

Use previous solutions for  $C_E(t)$  and  $C_I(t)$  above for  $C_{E0}$ ,  $C_{I0}$ ,  $V_{E0}$

Loop through solutions of equations D5 and D6 (n) times

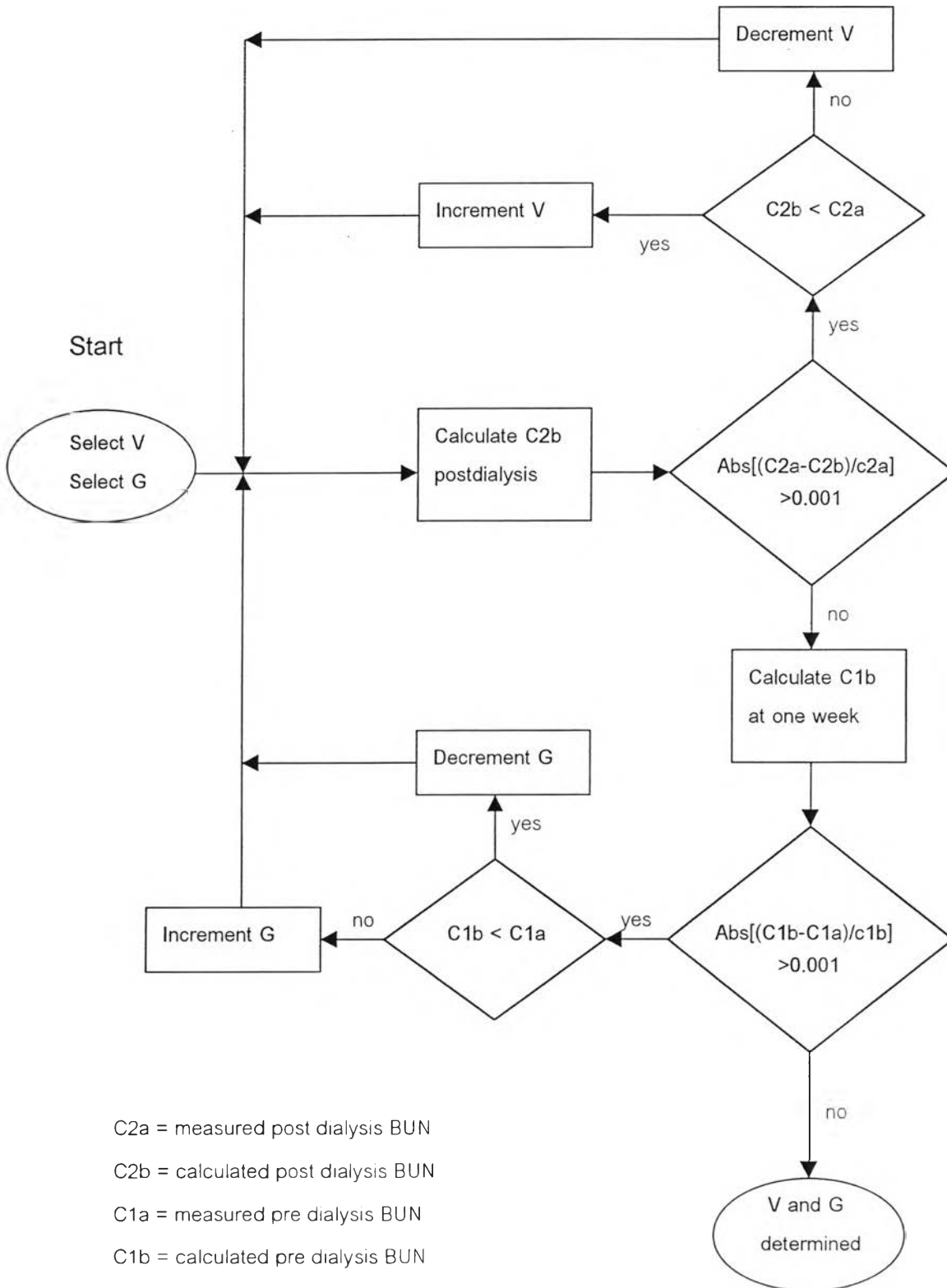
Repeat intradialysis and interdialysis solutions for  $C_E(t)$  and  $C_I(t)$  until a week of time has elapsed

$C_E$  should match the measured pre dialysis BUN.

If  $C_E$  does not match, adjust G and repeat from the beginning.

This establishes G.

ภาคผนวก ข แผนภูมิแสดงขั้นตอนและลำดับการวนรอบของวิธีการหาคำตอบเชิง  
 จำนวนของวิธี Double Pool, Variable-Extracellular Volume Urea Kinetic Model



End

ภาคผนวก ค ตัวอย่างการใช้งานจริงโดยโปรแกรมภาษา C++ สำหรับการคำนวณตามวิธี  
การหาค่าตอบเชิงจำนวนของวิธี **Double Pool, Variable-Extracellular Volume Urea  
Kinetic Model**

Start Processing

=====

Period = 2  
Tdown = 300  
Tup[1] = 5460  
Tup[2] = 4020  
Qf[1] = -2.33  
Qf[2] = -2.33  
Qwg[1] = 0.128  
Qwg[2] = 0.174  
Kd = 184  
Kcu = 800  
CeFinal = 0.102  
CeStart = 0.655

Adjust Ve0 Diff = 0.183 : Ve0 = 8005 : G = 2  
Adjust Ve0 Diff = 0.182 : Ve0 = 8010 : G = 2  
Adjust Ve0 Diff = 0.181 : Ve0 = 8015 : G = 2  
Adjust Ve0 Diff = 0.18 : Ve0 = 8020 : G = 2  
Adjust Ve0 Diff = 0.179 : Ve0 = 8025 : G = 2  
Adjust Ve0 Diff = 0.178 : Ve0 = 8030 : G = 2  
Adjust Ve0 Diff = 0.177 : Ve0 = 8035 : G = 2  
Adjust Ve0 Diff = 0.176 : Ve0 = 8040 : G = 2  
Adjust Ve0 Diff = 0.175 : Ve0 = 8045 : G = 2  
Adjust Ve0 Diff = 0.174 : Ve0 = 8050 : G = 2  
Adjust Ve0 Diff = 0.174 : Ve0 = 8055 : G = 2

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Adjust	Ve0	Diff	=	0.015 :	Ve0 = 8905 :	G = 2

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Adjust	Ve0	Diff	=	0.013 :	Ve0 = 8915 :	G = 2
Adjust	Ve0	Diff	=	0.012 :	Ve0 = 8920 :	G = 2
Adjust	Ve0	Diff	=	0.011 :	Ve0 = 8925 :	G = 2
Adjust	Ve0	Diff	=	0.01 :	Ve0 = 8930 :	G = 2
Adjust	Ve0	Diff	=	0.009 :	Ve0 = 8935 :	G = 2
Adjust	Ve0	Diff	=	0.008 :	Ve0 = 8940 :	G = 2
Adjust	Ve0	Diff	=	0.007 :	Ve0 = 8945 :	G = 2
Adjust	Ve0	Diff	=	0.006 :	Ve0 = 8950 :	G = 2
Adjust	Ve0	Diff	=	0.005 :	Ve0 = 8955 :	G = 2
Adjust	Ve0	Diff	=	0.004 :	Ve0 = 8960 :	G = 2
Adjust	Ve0	Diff	=	0.004 :	Ve0 = 8965 :	G = 2
Adjust	Ve0	Diff	=	0.003 :	Ve0 = 8970 :	G = 2
Adjust	Ve0	Diff	=	0.002 :	Ve0 = 8975 :	G = 2
Adjust	Ve0	Diff	=	0.001 :	Ve0 = 8975 :	G = 2
Adjust	G0	Diff	=	0.611 :	Ve0 = 8975 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8975 :	G = 2
Adjust	G0	Diff	=	0.603 :	Ve0 = 8976 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8976 :	G = 2
Adjust	G0	Diff	=	0.596 :	Ve0 = 8976 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8976 :	G = 2
Adjust	G0	Diff	=	0.588 :	Ve0 = 8976 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8971 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8971 :	G = 2
Adjust	G0	Diff	=	0.58 :	Ve0 = 8972 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8967 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8967 :	G = 2
Adjust	G0	Diff	=	0.572 :	Ve0 = 8967 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8967 :	G = 2
Adjust	G0	Diff	=	0.565 :	Ve0 = 8968 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8963 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8963 :	G = 2
Adjust	G0	Diff	=	0.557 :	Ve0 = 8963 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8963 :	G = 2

Adjust	G0	Diff	=	0.55 :	Ve0	=	8963 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8958 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8958 :	G	=	2
Adjust	G0	Diff	=	0.542 :	Ve0	=	8959 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8959 :	G	=	2
Adjust	G0	Diff	=	0.535 :	Ve0	=	8959 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8954 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8954 :	G	=	2
Adjust	G0	Diff	=	0.528 :	Ve0	=	8954 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8954 :	G	=	2
Adjust	G0	Diff	=	0.521 :	Ve0	=	8955 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8950 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8950 :	G	=	2
Adjust	G0	Diff	=	0.514 :	Ve0	=	8950 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8945 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8945 :	G	=	2
Adjust	G0	Diff	=	0.506 :	Ve0	=	8945 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8945 :	G	=	2
Adjust	G0	Diff	=	0.5 :	Ve0	=	8946 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8941 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8941 :	G	=	2
Adjust	G0	Diff	=	0.493 :	Ve0	=	8941 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8941 :	G	=	2
Adjust	G0	Diff	=	0.486 :	Ve0	=	8941 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8936 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8936 :	G	=	2
Adjust	G0	Diff	=	0.479 :	Ve0	=	8937 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8937 :	G	=	2
Adjust	G0	Diff	=	0.472 :	Ve0	=	8937 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8932 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8932 :	G	=	2
Adjust	G0	Diff	=	0.466 :	Ve0	=	8933 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8928 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8928 :	G	=	2

Adjust	G0	Diff	=	0.459 :	Ve0	=	8928 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8928 :	G	=	2
Adjust	G0	Diff	=	0.452 :	Ve0	=	8928 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8923 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8923 :	G	=	2
Adjust	G0	Diff	=	0.446 :	Ve0	=	8924 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8924 :	G	=	2
Adjust	G0	Diff	=	0.44 :	Ve0	=	8924 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8919 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8919 :	G	=	2
Adjust	G0	Diff	=	0.433 :	Ve0	=	8919 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8919 :	G	=	2
Adjust	G0	Diff	=	0.427 :	Ve0	=	8920 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8915 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8915 :	G	=	2
Adjust	G0	Diff	=	0.42 :	Ve0	=	8915 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8910 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8910 :	G	=	2
Adjust	G0	Diff	=	0.414 :	Ve0	=	8910 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8910 :	G	=	2
Adjust	G0	Diff	=	0.408 :	Ve0	=	8911 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8906 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8906 :	G	=	2
Adjust	G0	Diff	=	0.402 :	Ve0	=	8906 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8906 :	G	=	2
Adjust	G0	Diff	=	0.396 :	Ve0	=	8907 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8902 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8902 :	G	=	2
Adjust	G0	Diff	=	0.389 :	Ve0	=	8902 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8897 :	G	=	2
Adjust	Ve0	Diff	=	0 :	Ve0	=	8897 :	G	=	2
Adjust	G0	Diff	=	0.383 :	Ve0	=	8897 :	G	=	2
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8897 :	G	=	2
Adjust	G0	Diff	=	0.378 :	Ve0	=	8898 :	G	=	2

Adjust	Ve0	Diff	=	-0 :	Ve0 = 8893 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8893 :	G = 2
Adjust	G0	Diff	=	0.371 :	Ve0 = 8893 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8893 :	G = 2
Adjust	G0	Diff	=	0.366 :	Ve0 = 8893 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8888 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8888 :	G = 2
Adjust	G0	Diff	=	0.36 :	Ve0 = 8889 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8889 :	G = 2
Adjust	G0	Diff	=	0.354 :	Ve0 = 8889 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8884 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8884 :	G = 2
Adjust	G0	Diff	=	0.348 :	Ve0 = 8884 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8879 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8879 :	G = 2
Adjust	G0	Diff	=	0.343 :	Ve0 = 8880 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8880 :	G = 2
Adjust	G0	Diff	=	0.337 :	Ve0 = 8880 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8875 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8875 :	G = 2
Adjust	G0	Diff	=	0.331 :	Ve0 = 8875 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8875 :	G = 2
Adjust	G0	Diff	=	0.326 :	Ve0 = 8876 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8871 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8871 :	G = 2
Adjust	G0	Diff	=	0.321 :	Ve0 = 8871 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8871 :	G = 2
Adjust	G0	Diff	=	0.315 :	Ve0 = 8872 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8867 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8867 :	G = 2
Adjust	G0	Diff	=	0.31 :	Ve0 = 8867 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8862 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8862 :	G = 2
Adjust	G0	Diff	=	0.304 :	Ve0 = 8862 :	G = 2



Adjust	Ve0	Diff	=	-0 :	Ve0 = 8862 :	G = 2
Adjust	G0	Diff	=	0.299 :	Ve0 = 8863 :	G = 2
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8858 :	G = 2
Adjust	Ve0	Diff	=	0 :	Ve0 = 8858 :	G = 2
Adjust	G0	Diff	=	0.294 :	Ve0 = 8858 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8858 :	G = 3
Adjust	G0	Diff	=	0.289 :	Ve0 = 8858 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8853 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8853 :	G = 3
Adjust	G0	Diff	=	0.283 :	Ve0 = 8854 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8854 :	G = 3
Adjust	G0	Diff	=	0.278 :	Ve0 = 8854 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8849 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8849 :	G = 3
Adjust	G0	Diff	=	0.273 :	Ve0 = 8849 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8844 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8844 :	G = 3
Adjust	G0	Diff	=	0.268 :	Ve0 = 8845 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8845 :	G = 3
Adjust	G0	Diff	=	0.263 :	Ve0 = 8845 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8840 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8840 :	G = 3
Adjust	G0	Diff	=	0.258 :	Ve0 = 8840 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8840 :	G = 3
Adjust	G0	Diff	=	0.253 :	Ve0 = 8841 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8836 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8836 :	G = 3
Adjust	G0	Diff	=	0.248 :	Ve0 = 8836 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8836 :	G = 3
Adjust	G0	Diff	=	0.243 :	Ve0 = 8837 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8832 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8832 :	G = 3
Adjust	G0	Diff	=	0.238 :	Ve0 = 8832 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8827 :	G = 3

Adjust	Ve0	Diff	=	0 :	Ve0 = 8827 :	G = 3
Adjust	G0	Diff	=	0.233 :	Ve0 = 8827 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8827 :	G = 3
Adjust	G0	Diff	=	0.229 :	Ve0 = 8828 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8823 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8823 :	G = 3
Adjust	G0	Diff	=	0.224 :	Ve0 = 8823 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8823 :	G = 3
Adjust	G0	Diff	=	0.219 :	Ve0 = 8823 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8818 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8818 :	G = 3
Adjust	G0	Diff	=	0.214 :	Ve0 = 8819 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8819 :	G = 3
Adjust	G0	Diff	=	0.21 :	Ve0 = 8819 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8814 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8814 :	G = 3
Adjust	G0	Diff	=	0.205 :	Ve0 = 8814 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8809 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8809 :	G = 3
Adjust	G0	Diff	=	0.2 :	Ve0 = 8810 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8810 :	G = 3
Adjust	G0	Diff	=	0.196 :	Ve0 = 8810 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8805 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8805 :	G = 3
Adjust	G0	Diff	=	0.191 :	Ve0 = 8806 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8806 :	G = 3
Adjust	G0	Diff	=	0.187 :	Ve0 = 8806 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8801 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8801 :	G = 3
Adjust	G0	Diff	=	0.183 :	Ve0 = 8801 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8801 :	G = 3
Adjust	G0	Diff	=	0.178 :	Ve0 = 8802 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8797 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8797 :	G = 3

Adjust	G0	Diff	=	0.174 :	Ve0	=	8797 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8792 :	G	=	3
Adjust	Ve0	Diff	=	0 :	Ve0	=	8792 :	G	=	3
Adjust	G0	Diff	=	0.169 :	Ve0	=	8792 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8792 :	G	=	3
Adjust	G0	Diff	=	0.165 :	Ve0	=	8793 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8788 :	G	=	3
Adjust	Ve0	Diff	=	0 :	Ve0	=	8788 :	G	=	3
Adjust	G0	Diff	=	0.161 :	Ve0	=	8788 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8788 :	G	=	3
Adjust	G0	Diff	=	0.157 :	Ve0	=	8788 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8783 :	G	=	3
Adjust	Ve0	Diff	=	0 :	Ve0	=	8783 :	G	=	3
Adjust	G0	Diff	=	0.152 :	Ve0	=	8784 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8784 :	G	=	3
Adjust	G0	Diff	=	0.148 :	Ve0	=	8784 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8779 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8779 :	G	=	3
Adjust	G0	Diff	=	0.144 :	Ve0	=	8779 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8774 :	G	=	3
Adjust	Ve0	Diff	=	0 :	Ve0	=	8774 :	G	=	3
Adjust	G0	Diff	=	0.14 :	Ve0	=	8775 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8775 :	G	=	3
Adjust	G0	Diff	=	0.136 :	Ve0	=	8775 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8770 :	G	=	3
Adjust	Ve0	Diff	=	0 :	Ve0	=	8770 :	G	=	3
Adjust	G0	Diff	=	0.131 :	Ve0	=	8771 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8771 :	G	=	3
Adjust	G0	Diff	=	0.128 :	Ve0	=	8771 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8766 :	G	=	3
Adjust	Ve0	Diff	=	0 :	Ve0	=	8766 :	G	=	3
Adjust	G0	Diff	=	0.123 :	Ve0	=	8766 :	G	=	3
Adjust	Ve0	Diff	=	-0 :	Ve0	=	8761 :	G	=	3
Adjust	Ve0	Diff	=	0 :	Ve0	=	8761 :	G	=	3

Adjust	G0	Diff	=	0.119 :	Ve0 = 8762 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8762 :	G = 3
Adjust	G0	Diff	=	0.115 :	Ve0 = 8762 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8757 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8757 :	G = 3
Adjust	G0	Diff	=	0.111 :	Ve0 = 8757 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8757 :	G = 3
Adjust	G0	Diff	=	0.108 :	Ve0 = 8758 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8753 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8753 :	G = 3
Adjust	G0	Diff	=	0.104 :	Ve0 = 8753 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8753 :	G = 3
Adjust	G0	Diff	=	0.1 :	Ve0 = 8753 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8748 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8748 :	G = 3
Adjust	G0	Diff	=	0.096 :	Ve0 = 8749 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8744 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8744 :	G = 3
Adjust	G0	Diff	=	0.092 :	Ve0 = 8744 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8744 :	G = 3
Adjust	G0	Diff	=	0.088 :	Ve0 = 8745 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8740 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8740 :	G = 3
Adjust	G0	Diff	=	0.084 :	Ve0 = 8740 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8740 :	G = 3
Adjust	G0	Diff	=	0.081 :	Ve0 = 8740 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8735 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8735 :	G = 3
Adjust	G0	Diff	=	0.077 :	Ve0 = 8736 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8736 :	G = 3
Adjust	G0	Diff	=	0.073 :	Ve0 = 8736 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8731 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8731 :	G = 3
Adjust	G0	Diff	=	0.07 :	Ve0 = 8731 :	G = 3

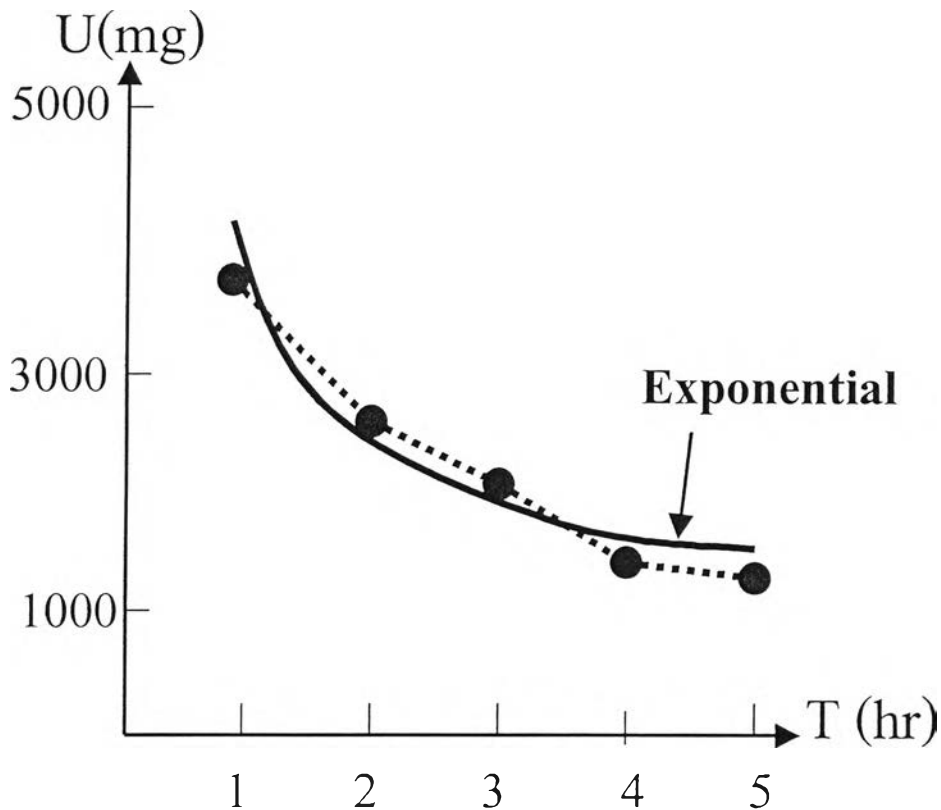
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8726 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8726 :	G = 3
Adjust	G0	Diff	=	0.066 :	Ve0 = 8727 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8727 :	G = 3
Adjust	G0	Diff	=	0.062 :	Ve0 = 8727 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8722 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8722 :	G = 3
Adjust	G0	Diff	=	0.059 :	Ve0 = 8722 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8722 :	G = 3
Adjust	G0	Diff	=	0.055 :	Ve0 = 8723 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8718 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8718 :	G = 3
Adjust	G0	Diff	=	0.051 :	Ve0 = 8718 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8718 :	G = 3
Adjust	G0	Diff	=	0.048 :	Ve0 = 8718 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8713 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8713 :	G = 3
Adjust	G0	Diff	=	0.044 :	Ve0 = 8714 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8709 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8709 :	G = 3
Adjust	G0	Diff	=	0.041 :	Ve0 = 8709 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8709 :	G = 3
Adjust	G0	Diff	=	0.037 :	Ve0 = 8710 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8705 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8705 :	G = 3
Adjust	G0	Diff	=	0.034 :	Ve0 = 8705 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8705 :	G = 3
Adjust	G0	Diff	=	0.031 :	Ve0 = 8705 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8700 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8700 :	G = 3
Adjust	G0	Diff	=	0.027 :	Ve0 = 8701 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8696 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8696 :	G = 3
Adjust	G0	Diff	=	0.023 :	Ve0 = 8696 :	G = 3

Adjust	Ve0	Diff	=	-0 :	Ve0 = 8696 :	G = 3
Adjust	G0	Diff	=	0.02 :	Ve0 = 8696 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8691 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8691 :	G = 3
Adjust	G0	Diff	=	0.017 :	Ve0 = 8692 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8692 :	G = 3
Adjust	G0	Diff	=	0.014 :	Ve0 = 8692 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8687 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8687 :	G = 3
Adjust	G0	Diff	=	0.01 :	Ve0 = 8687 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8687 :	G = 3
Adjust	G0	Diff	=	0.007 :	Ve0 = 8688 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8683 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8683 :	G = 3
Adjust	G0	Diff	=	0.004 :	Ve0 = 8683 :	G = 3
Adjust	Ve0	Diff	=	-0 :	Ve0 = 8678 :	G = 3
Adjust	Ve0	Diff	=	0 :	Ve0 = 8678 :	G = 3
Adjust	G0	Diff	=	0 :	Ve0 = 8678 :	G = 3

The answer with  $Ve = 8678.5$

0

ภาคผนวก ง วิธีการหาปริมาณยูเรียในน้ำยา dialysate ทั้งหมด ตามวิธี modified Direct Dialysate Quantitative method โดยการเก็บน้ำยา dialysate เป็นจุดเวลาทุกชั่วโมง (Dspot)



Plot graph 1

$$U_{(n)} = C_{d(n)} * V_{d(n)} \quad [\text{at } n = 1, 2, 3 \text{ to } t \text{ (hr)}]$$

Exponential estimation of graph 1

$$Y = a * e^{-bx}$$

Estimate U by integrate exponential equation from 0 – 5 (from 0-4 if dialysis time = 4 hr)

$$U = \int_0^5 y \, dx$$

$U_{(n)}$  = urea removal in dialysate at  $n^{\text{th}}$  hour

$C_{d(n)}$  = urea concentration in dialysate at end of  $n^{\text{th}}$  hour

$V_{d(n)}$  = volume of dialysate at  $n^{\text{th}}$  hour

a, b = constant

U = total urea removal in dialysate

## ประวัติผู้เขียน

นาย ธนิต จิรนนท์ธวัช เกิดวันที่ 25 มิถุนายน 2511 ที่กรุงเทพมหานคร สำเร็จการศึกษาปริญญาตรี แพทยศาสตรบัณฑิต คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ในปีการศึกษา 2535 จากนั้นเข้ารับราชการเป็นแพทย์ประจำงานอายุรกรรม โรงพยาบาลตำรวจ ในปีพ.ศ. 2535-2536 และได้เข้ารับการศึกษาต่อเป็นแพทย์ประจำบ้านของแผนกอายุรกรรม โรงพยาบาลจุฬาลงกรณ์ ในปีพ.ศ. 2536-2539 จนสำเร็จได้วุฒิบัตรผู้มีความรู้ความชำนาญในสาขาวิชาอายุรศาสตร์ จากนั้นกลับเข้ารับราชการที่งานอายุรกรรม โรงพยาบาลตำรวจ ในปีพ.ศ. 2539-2540 และเข้าศึกษาต่อในหลักสูตรวิทยาศาสตรมหาบัณฑิต (สาขาอายุรศาสตร์โรคไต) ณ ภาควิชาอายุรศาสตร์ คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย เมื่อปี พ.ศ. 2540 หลังจากจบการศึกษาในปี พ.ศ. 2542 แล้ว จะกลับเข้ารับราชการที่หน่วยโรคไต งานอายุรกรรม โรงพยาบาลตำรวจ

