AIR QUALITY STANDARD FOR LEAD

TEH 0470361.001

Percentile	Z
90	1.282
97.5	1.96
98	2.054
99	2.326

The Log Normal Assumption Has Little Effect at the 50 Percentile

Data	Log Model		Gamma Model	
	Pearson	Log	Pearson	Log
Agar	4.2, 4.8	5.2	4.3, 4.4	4.7
Okeana	5.2	5.9	4.4	4.7
Ardmore	2.3	3.3 *	2.4	3.2 *
Rittenhouse	1.3	1.2	1.3	1.2
Pasadena	7.7	7.7	5.9	5.9
Los Alamos M	3.1	2.8	3.2	3.0
" " F	6.4	6.9	5.0	5.2
Wash DC	1.9	2.0	2.0	2.1
Port Wash	9.1	8.5	5.9	4.6 *
Greenwich Village	8.0	7.5	5.7	5.5
Lombard	13.7	13.7	7.2	7.2
Bridgeport	5.6	4.9	4.6	4.2
Houston	19.4	20.0	8.1	8.2

AIR QUALITY STANDARD FOR LEAD

- DISTRIBUTION OF BLOOD Pb's TO PROVIDE ESTIMATES OF PERCENTILES
  - PEARSON FIT TO OBSERVED DISTRIBUTION
  - LOG NORMAL

- MODEL FOR AIR Pb - BLOOD Pb RELATION
  - LINEAR MODEL WITH SLOPE = 1

    $$\text{BLOOD Pb} = b_0 + (1)\,\text{AIR Pb}$$

  - LOG MODEL FOR AZAR DATA

    $$\text{BLOOD Pb} = 12.1\,(\text{AIR Pb} + 3.28)^{.27}$$

- BIOLOGICAL QUALITY GUIDE FOR Pb (ZIELHUIS' DISTRIBUTION)

PERCENTILE	BLOOD Pb
90	30 μg/100g
98	35 μg/100g

TEH 0470364

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- STRATEGY
  - ESTIMATE BLOOD Pb PERCENTILES
  - CALCULATE AIR Pb NEEDED TO EQUATE OBSERVED PERCENTILE WITH ZIELHUIS DISTRIBUTION

- DATA BASE
  - AZAR et al
  - SEVEN CITIES

AZAR DATA

AIR Pb's ASSOCIATED WITH BLOOD Pb PERCENTILES

BLOOD Pb DIST'BN	PERCENT	LINEAR MODEL BLOOD Pb	LINEAR MODEL AIR Pb	LOG MODEL BLOOD Pb	LOG MODEL AIR Pb
PEARSON FIT	90	23.2	6.8	22.4	6.5
	97.5	28.5	6.5	26.9	5.5
	~~99~~	~~31.9~~		~~29.7~~	
	~~AVG *~~		~~6.6~~		~~6.0~~
LOG NORMAL	90	23.8	6.2	22.9	5.7
	97.5	30.1	4.9	28.2	4.1
	98	31.0	4.0	29.0	3.4
	99	34.1		31.5	
	AVG		5.6		4.9
NORMAL POWER (λ=.3)	90	23.5	6.5	22.6	6.2
	97.5	28.6	6.4	27.1	5.3
	98	29.4	5.6	27.8	4.5
	~~99~~	~~31.7~~		~~29.7~~	
	~~AVG~~		~~6.4~~		~~5.8~~

* ~~AVERAGE OF AIR Pb's ASSOCIATED WITH 90TH AND~~ 97.5 BLOOD Pb PERCENTILES

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SEVEN CITIES STUDY

AVERAGE OF AIR Pb'S ASSOCIATED WITH THE 90TH AND 97.5 BLOOD Pb PERCENTILES

	LINEAR MODEL		LOG MODEL	
LOCATION	PEARSON FIT	LOG NORMAL	PEARSON FIT	LOG NORMAL
OKEANA	7.5	6.4	6.0	4.6
ARDMORE	5.8	3.4	4.5	2.6
ITTENHOUSE	1.7	1.8	1.7	1.8
ASADENA	8.4	8.4	9.4	9.4
OS ALAMOS(M)	6.8 > 3.8	7.5 > 2.7	4.9 > 6.6	5.7 > 4.9
OS ALAMOS(F)	10.6	10.2	11.5	10.6
VASH., DC	5.9	5.8	4.7	4.6
ORT WASH	10.2	10.6	11.9	12.9
REENWICH VILLAGE	9.4	9.8	10.7	11.6
OMBARD	12.8	12.9	20.0	20.5
RIDGEPORT	7.3	8.4	7.0	10.1
HOUSTON	14.0	13.6	25.8	24.1

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DOES THE AIR Pb - BLOOD Pb SLOPE = 1 ?

Pb EXPOSURE MODEL FOR AZAR DATA

$$\text{BLOOD Pb} = 12.1\ (\text{AIR Pb} + 3.28)^{.27}$$

AIR Pb	BLOOD Pb	SLOPE
0	16.7	1.2
1	17.9	1.0
2	18.9	0.8
5	21.3	0.6
10	24.2	

0-10 AVG SLOPE $= \frac{24.2-16.7}{10-0} = 0.75$

0-5 AVG SLOPE $= \frac{21.3-16.7}{5-0} = 0.92$

1/14/77

COMMENTS

1. SLOPE = 1 is reasonable

2. Blood Pb distribution is not log normal

3. Alternative Procedure

   - Ayer Data to estimate average air Pb – blood Pb relation

   - 7 cities data to estimate BLOOD Pb frequency distribution

4. Zielhuis Diathin

   - 50% point consistent with 90 & 95% point for normal distribution only

   - 50% point is not consistent for log normal and $\lambda = 0.3$ normal distribution

   - 50% point is too low -- suggest 22–24 instead of 20

SEVEN CITIES. DATA

SITE	PERCENT	PEARSON FIT BLOOD Pb	PEARSON FIT AIR Pb LINEAR	PEARSON FIT AIR Pb LOG	LOG NORMAL BLOOD Pb	LOG NORMAL AIR Pb LINEAR
OKEANA	90	23.0	7.3	6.5	23.6	6.7
	97.5	27.6	7.7	5.5	29.3	6.0
	98				30.2	5.1
	AVG*		7.5	6.0		6.4
ARDMORE	90	26.1	5.1	4.2	27.1	4.1
	97.5	29.8	6.4	4.8	33.6	2.6
	98				34.6	1.6
	AVG		5.8	4.5		3.4
RITTENHOUSE	90	29.5	2.2	2.0	29.3	2.4
	97.5	35.6	1.2	1.4	35.4	1.3
	98				36.4	0.3
	AVG		1.7	1.7		1.8
PASADENA	90	25.0	8.4	9.9	24.9	8.5
	97.5	29.9	8.5	8.8	30.0	8.4
	98				30.8	7.6
	AVG		8.4	9.4		8.4
LOS ALAMOS MALE	90	23.5	6.7	5.3	23.2	7.0
	97.5	28.2	7.0	4.5	27.2	8.0
	98				27.8	7.4
	AVG		6.8	4.9		7.5
LOS ALAMOS FEMALE	90	20.3	9.9	11.6	20.6	9.6
	97.5	23.8	11.4	11.4	24.3	10.9
	98				24.9	10.3
	AVG		10.6	11.5		10.2

* AVERAGE OF 90TH AND 97.5 PERCENTILES

SEVEN CITIES DATA (CONTINUED)

SITE	PERCENT	PEARSON FIT BLOOD Pb	PEARSON FIT AIR Pb LINEAR	PEARSON FIT AIR Pb LOG	LOG NORMAL BLOOD Pb	LOG NORMAL AIR Pb LINEAR	LOG NORMAL AIR Pb LOG
WASH., DC	90	26.0	5.2	4.4	25.7	6.5	4.7
	97.5	29.6	6.6	5.1	30.1	6.1	4.6
	98				30.7	5.5	4.0
	AVG*		5.9	4.7		5.8	4.6
PORT WASHINGTON	90	21.4	9.7	12.4	21.1	10.0	13.2
	97.5	25.4	10.7	11.4	24.9	11.2	12.5
	98				25.5	10.6	11.2
	AVG		10.2	11.9		10.6	12.9
GREENWICH VILLAGE	90	22.9	9.2	11.5	22.7	9.4	12.0
	97.5	27.5	9.6	10.0	26.8	10.3	11.3
	98				27.5	9.6	10.0
	AVG		9.4	10.7		9.8	11.6
LOMBARD	90	19.0	12.2	21.4	19.1	12.1	20.9
	97.5	22.9	13.3	18.6	22.5	13.7	20.1
	98				23.0	13.2	18.2
	AVG		12.8	20.0		12.9	20.5
BRIDGEPORT	90	24.2	7.6	8.0	23.9	7.9	11.8
	97.5	29.8	7.0	5.9	28.0	8.8	8.3
	98				28.7	8.1	7.3
	AVG		7.3	7.0		8.4	10.1
HOUSTON	90	17.8	13.0	25.9	17.8	13.0	25.9
	97.5	20.8	15.0	25.7	21.5	14.3	22.4
	98				22.1	13.7	19.8
	AVG		14.0	25.8		13.6	24.1

* AVERAGE OF 90TH AND 97.5TH PERCENTILES

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LOG BLOOD Pb DISTRIBUTION

DATA SET	n	$\bar{X}$	S	$\sqrt{\beta_1}$	β_2
AZAR (B-A)	149	1.186	.199	−.35*	3.27
" (ADJ 1)	149	1.176	.130	−.28+	2.97
" (ADJ 2)	149	1.189	.133	−.31+	2.90
OKEANA	162	1.194	.139	−.81**	6.47**
ARDMORE	150	1.256	.138	−.76**	3.87*
RITTENHOUSE	136	1.312	.121	.10	2.84
PASADENA	193	1.249	.119	−.06	3.42+
LOS ALAMOS (M)	80	1.236	.101	.44*	3.05
LOS ALAMOS (F)	191	1.176	.107	−.34*	3.95*
WASH., D.C.	219	1.282	.100	.06	2.92
PORT WASH.	198	1.188	.106	.20	3.09
GREENWICH VILLAGE	140	1.219	.107	.21	3.28
LOMBARD	208	1.147	.105	−.13	4.92**
BRIDGEPORT	147	1.246	.103	.55**	3.59+
HOUSTON	191	1.099	.119	−.09	2.59
AZAR $(B-A)^{.3}$	149	2.281	.232	−.01	3.17
" $(ADJ1)^{.3}$	149	2.262	.202	−.01	3.09
" $(ADJ2)^{.3}$	149	2.283	.208	−.05	3.00

* DISTRIBUTION NOT NORMAL ($p < .05$)

** " " " " ($p < .01$)

\+ DEVIATION FROM NORMALITY ALMOST SIGNIFICANT AT THE .05 PROBABILITY LEVEL ($p < .05$).

AZAR DATA

AIR QUALITY STANDARD (AQS) FOR LEAD

	AQS ($\mu gm/m^3$)	
	LINEAR MODEL	LOG MODEL
PEARSON	6.6	6.0
LOG NORMAL	5.6	4.9
POWER NORMAL	6.4	5.8

AZAR DATA

SUMMARY OF 50 PERCENTILE RESULTS

CASE I	BLOOD Pb	AQV	"AQV+3" Z	
Log Model	15.8	4.7	10.1	(23)
Pearson System			8.1	(22)
Case II				
Log Model	15.7	4.8	10.4	(23)
Normal (Blood Pb)$^{.3}$			8.3	(22)
Case III				
Linear Model Pearson System	15.7	4.3	7.3	
Case IV				
Linear Model Normal (Blood Pb)$^{.3}$	15.6	4.4	7.4	

NORMAL DISTBN

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PERCENTILE	$(B-A)^{.3}$	AQS	
50	15.6	4.4	
90	23.5	6.5	6.4
97.5	28.6	6.4	
98	29.4	5.6	
99	31.7		

	$(ADJ\ 1)^{.3}$		
50	15.2	4.5	
90	21.8	5.8	5.4
97.5	26.0	5.1	
98	26.6	4.5	
99	28.5		

	$(ADJ\ 2)^{.3}$		
50	15.7	4.8	
90	22.6	6.2	5.8
97.5	27.1	5.3	
98	27.8	4.5	
99	29.7		

	$(ADJ\ 2)^{.35}$		
50	15.7	4.8	
90	22.6	6.2	5.8
97.5	26.9	5.5	
98	27.6	4.7	
99	29.5		

Percentile	B-A				
50	15.7	+	4.3	= 20 ←	
90	23.2	+	6.8	= 30	} 6.6
97.5	28.5	+	6.5	= 35	
99	31.9				

AVG = 5.9

Percentile	log (B-A)				
50	15.6	+	4.4	= 20	
90	23.5	+	6.5	= 30	} 6.4
97.5	28.8	+	6.2	= 35	
99	32.1				

AVG = 5.7

Percentile	(log B-A) − Log Normal				
50	15.~~6~~3	+	4.~~4~~7	= 20 ←	
90	23.8	+	6.2	= 30	} 5.6
97.5	30.1	+	4.9	= 35	
98	31.0	+	4.0	= 35	
99	34.1				

AVG = ~~5.2~~ 5.3

C = 2.50

Percentile	ADJ 1		
50	15.2 + 4.8 = 20	4.5	
90	21.6 + 8.4 = 30	6.1	5.6
97.5	26.0 + 9.0 = 35	5.1	
99	28.9		
	AVG = 7.4	5.2	

Percentile	Yog (ADJ 1)		
50	15.1 + 4.9 = 20	4.7	
90	21.9 + 8.1 = 30	5.6	5.3
97.5	26.1 + 8.9 = 35	5.0	
99	28.6		
	AVG = 7.3	5.1	

Percentile	Yog (ADJ 1) - Yog Normal		
50	15.0 + 5.0 = 20	4.8	
90	22.0 + 8.0 = 30	5.5	4.8
97.5	27.0 + 8.0 = 35	4.1	
98	27.7 + 7.3 = 35	3.5	
99	30.1		
	AVG = 7.0	4.8	

$\bar{C} = 3.28$

Percentile	adj 2		
50	15.8 + 4.2 = 20	4.7	
90	22.4 + 7.6 = 30	6.5	6.0
97.5	26.9 + 8.1 = 35	5.5	
99	29.7		
	AVG = 6.6	5.6	

Percentile	Log(adj 2)		
50	15.7 + 4.3 = 20	4.8	
90	22.7 + 7.3 = 30	6.0	5.9
97.5	26.7 + 8.3 = 35	5.8	
99	28.8		
	AVG = 6.6	5.5	

Percentile	Log(adj 2) - Log Normal		
50	15.5 + 4.5 = 20	5.2	
90	22.9 + 7.1 = 30	5.7	4.9
97.5	28.2 + 6.8 = 35	4.1	
98	29.0 + 6.0 = 35	3.4	
99	31.5		
	AVG = 6.1		

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Percentile	B-A
50	15.7 + 4.3 = 20
90	23.2 + 6.8 = 30
97.5	28.5 + 6.5 = 35
99	31.9

AVG = 5.9

Percentile	log (B-A)
50	15.6 + 4.4 = 20
90	23.5 + 6.5 = 30
97.5	28.8 + 6.2 = 35
99	32.1

AVG = 5.7

Percentile	(log B-A) - Log Normal
50	15.6 + 4.4 = 20
90	23.8 + 6.2 = 30
97.5	30.1 + 4.9 = 35
98	31.0 + 4.0 = 35
99	34.1

AVG = 5.2

Percentile	ADJ 1
50	15.2 + 4.8 = 20
90	21.6 + 8.4 = 30
97.5	26.0 + 9.0 = 35
99	28.9
	AVG = 7.4

Percentile	Yog (ADJ 1)
50	15.1 + 4.9 = 20
90	21.9 + 8.1 = 30
97.5	26.1 + 8.9 = 35
99	28.6
	AVG = 7.3

Percentile	Yog (ADJ 1) - Yog Normal
50	15.0 + 5.0 = 20
90	22.0 + 8.0 = 30
97.5	27.0 + 8.0 = 35
98	27.7 + 7.3 = 35
99	30.1
	AVG = 7.0

Percentile	adj 2
50	15.8 + 4.2 = 20
90	22.4 + 7.6 = 30
97.5	26.9 + 8.1 = 35
99	29.7
	AVG = 6.6

Percentile	Log(adj 2)
50	15.7 + 4.3 = 20
90	22.7 + 7.3 = 30
97.5	26.7 + 8.3 = 35
99	28.8
	AVG = 6.6

Percentile	Log(adj 2) − Log Normal
50	15.5 + 4.5 = 20
90	22.9 + 7.1 = 30
97.5	28.2 + 6.8 = 35
98	29.0 + 6.0 = 35
99	31.5
	AVG = 6.1

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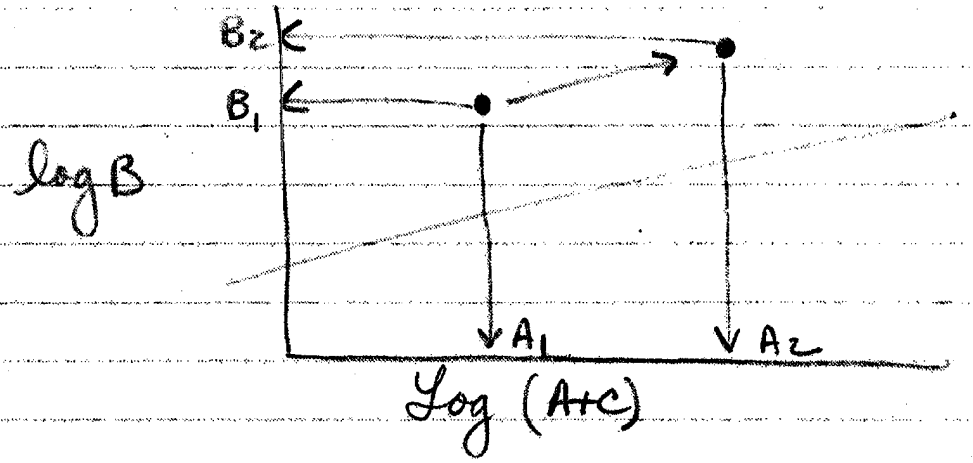
7-CITIES DATA – Pb EXPOSURE ADJ



$$\log B_2 = \log B_1 - b\left[\log(A_1+C) - \log(A_2+C)\right]$$

$$\frac{\log B_2 - \log B_1}{-b} = \log\left(\frac{A_1+C}{A_2+C}\right)$$

$$\log\left[\left(\frac{B_1}{B_2}\right)^{\frac{1}{b}}\right] = \log\left(\frac{A_1+C}{A_2+C}\right)$$

$$A_2 = (A_1+C)\left(\frac{B_1}{B_2}\right)^{-\frac{1}{b}} - C$$

$$= (A_1+C)\left(\frac{B_2}{B_1}\right)^{1/b} - C$$

A_1 = air Pb associated with the observed percentile B_1
A_2 = " " " " " " desired " B_2
b = slope
C = "background coefficient"

OKEANA (N = 162) Air Pb = .32

PERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS	
50	15.9 + 4.1 = 20	5.2	4.4	
90	23.0 + 7.0 = 30	6.5	7.3	7.5
97.5	27.6 + 7.4 = 35	5.5	7.7	
99	30.3	(6.0)		

	LOG BLOOD Pb PEARSON			
50	16.1 + 3.9 = 20		4.2	
90	22.5 + 7.5 = 30		7.8	7.8
97.5	27.4 + 7.6 = 35		7.9	
99	30.9			

	LOG NORMAL			
50	15.6 + 4.4 = 20	5.9	4.7	
90	23.6 + 6.4 = 30	5.6	6.7	6.4
97.5	29.3 + 5.7 = 35	3.7	6.0	
98	30.2 + 4.8 = 35	3.0	5.1	
99	32.9	(4.6)		

TEH 0470388

DUP050083207

ARDMORE (N = 150) airPb = 1.15

PERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS	
50	18.8 + 1.2 = 20	2.3	2.4	
90	26.1 + 3.9 = 30	4.2	5.1	5.8
97.5	29.8 + 5.2 = 35	4.8	6.4	
99	31.6	(4.5)		

	LOG BLOOD Pb PEARSON		
50	18.7 + 1.3 = 20	2.5	
90	26.2 + 3.8 = 30	5.0	5.4
97.5	30.3 + 4.7 = 35	5.9	
99	32.4		

	LOG NORMAL			
50	18.0 + 2 = 20	3.3	3.2	
90	27.1 + 2.9 = 30	3.2	4.1	3.4
97.5	33.6 + 1.4 = 35	1.9	2.6	
98	34.6 + 0.4 = 35	1.3	1.6	
99	37.8	(2.6)		

RITTENHOUSE (N = 136) AirPb = 1.67

PERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS	
50	20.4 + (-.4) = 20	1.3	1.3	
90	29.5 + (0.5) = 30	2.0	2.2	1.7
97.5	35.6 + (-.5) = 35	1.4	1.2	
99	39.4	(1.7)		

	LOG BLOOD Pb PEARSON		
50	20.5 + (-.5) = 20	1.2	
90	29.4 + (.6) = 30	2.3	1.9
97.5	35.2 + (-.2) = 35	1.5	
99	38.6		

	LOG NORMAL			
50	20.5 + (-.5) = 20	1.2	1.2	
90	29.3 + (.7) = 30	2.1	2.4	1.8
97.5	35.4 + (-.4) = 35	1.5	1.3	
98	36.4 + (-1.9) = 35	1.0	.3	
99	39.2	(1.8)		

TEH 0470390

DUP050083209

PASADENA (N = 193) Air Pb = 3.39

PERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS	
50	17.5 + 2.5 = 20	7.7	5.9	
90	25.0 + 5 = 30	9.9	8.4	8.4
97.5	29.9 + 5.1 = 35	8.8	8.5	
99	32.8	(9.4)		

	LOG BLOOD Pb PEARSON		
50	17.5 + 2.5 = 20	5.9	
90	24.7 + 5.3 = 30	8.7	8.5
97.5	30.1 + 4.9 = 35	8.3	
99	33.8		

	LOG-NORMAL			
50	17.5 + 2.5 = 20	7.7	5.9	
90	24.9 + 5.1 = 30	10.1	8.5	8.4
97.5	30.0 + 5.0 = 35	8.6	8.4	
98	30.8 + 4.2 = 35	7.5	7.6	
99	33.2	(9.4)		

TEH 0470391

DUP050083210

LOS ALAMOS - MALE (N=80) Air Pb = .17

PERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS	
50	17.0 + 3 = 20	3.1	3.2	
90	23.5 + 6.5 = 30	5.3	6.7	6.8
97.5	28.2 + 6.8 = 35	4.5	7.0	
99	31.2	(4.9)		

	LOG BLOOD Pb PEARSON		
50	16.9 + 3.1 = 20	3.3	
90	23.4 + 6.6 = 30	6.8	6.8
97.5	28.3 + 6.7 = 35	6.9	
99	31.3		

	LOG NORMAL			
50	17.2 + 2.8 = 20	2.8	3.0	
90	23.2 + 6.8 = 30	5.8	7.0	7.5
97.5	27.2 + 7.8 = 35	5.6	8.0	
98	27.8 + 7.2 = 35	4.9	7.4	
99	29.6	(5.7)		

TEH 0470392

DUP050083211

LOS ALAMOS - FEMALE (N=191) Air Pb = .17

PERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS	
50	15.2 + 4.8 = 20	6.4	5.0	
90	20.3 + 9.7 = 30	11.6	9.9	} 10.6
97.5	23.8 + 11.2 = 35	11.4	11.4	
99	26.0	(11.5)		

	LOG BLOOD Pb PEARSON		
50	15.2 + 4.8 = 20	5.0	
90	20.3 + 9.7 = 30	9.9	} 10.6
97.5	23.9 + 11.1 = 35	11.3	
99	26.3		

	LOG NORMAL			
50	15.0 + 5 = 20	6.9	5.2	
90	20.6 + 9.4 = 30	10.8	9.6	} 10.2
97.5	24.3 + 10.7 = 35	10.3	10.9	
98	24.9 + 10.1 = 35	9.1	10.3	
99	26.6	(10.6)		

WASHINGTON, D.C. (N=219) Air Pb = 1.19

PERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS
50	19.2 + 0.8 = 20	1.9	2.0
90	26.0 + 4.0 = 30	4.4	5.2 } 5.9
97.5	29.6 + 5.4 = 35	5.1	6.6 }
99	31.4	(4.7)	

	LOG BLOOD Pb PEARSON	
50	19.1 + 0.9 = 20	2.1
90	26.0 + 4.0 = 30	5.2 } 5.9
97.5	29.6 + 5.4 = 35	6.6 }
99	31.3	

	LOG NORMAL		
50	19.1 + 0.9 = 20	2.0	2.1
90	25.7 + 4.3 = 30	4.7	5.5 } 5.8
97.5	30.1 + 4.9 = 35	4.6	6.1 }
98	30.7 + 4.3 = 35	4.0	5.5
99	32.7	(4.6)	

PORT WASHINGTON (N=198) Air Pb = 1.13

ERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS	
50	15.2 + 4.8 = 20	9.1	5.9	
90	21.4 + 8.6 = 30	12.4	9.7	} 10.2
97.5	25.4 + 9.6 = 35	11.4	10.7	}
99	27.8	(11.9)		

LOG BLOOD Pb PEARSON

50	15.3 + 4.7 = 20	5.8	
90	21.1 + 8.9 = 30	10.0	} 10.4
97.5	25.2 + 9.8 = 35	10.9	}
99	27.8		

LOG NORMAL

50	15.4 + 4.6 = 20	8.5	4.6	
90	21.1 + 8.9 = 30	13.2	10.0	} 10.6
97.5	24.9 + 10.1 = 35	12.5	11.2	}
98	25.5 + 9.5 = 35	11.2	10.6	
99	27.2	(12.9)		

TEH 0470395

DUP050083214

GREENWICH VILLAGE (N=140) $Air Pb = 2.08$

PERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS
50	16.4 +3.6 = 20	8.0	5.7
90	22.9 +7.1 = 30	11.5	9.2 } 9.4
97.5	27.5 +7.5 = 35	10.0	9.6 }
99	30.4		
		10.7	

	LOG BLOOD Pb PEARSON	
50	16.4 +3.6 = 20	5.7
90	22.7 +7.3 = 30	9.4 } 9.5
97.5	27.5 +7.5 = 35	9.6 }
99	30.7	

	LOG NORMAL		
50	16.6 +3.4 = 20	7.5	5.5
90	22.7 +7.3 = 30	12.0	9.4 } 9.8
97.5	26.8 +8.2 = 35	11.3	10.3 }
98	27.5 +7.5 = 35	10.0	9.6
99	29.4		
		11.6	

TEH 0470396

DUP050083215

LOMBARD (N=208) Air Pb = 1.18

PERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS	
50	14.0 + 6 = 20	13.7	7.2	
90	19.0 + 11 = 30	21.4	12.2	} 12.8
97.5	22.9 + 12.1 = 35	18.6	13.3	
99	25.5	(20.0)		

	LOG-BLOOD Pb PEARSON		
50	14.1 + 5.9 = 20	7.1	
90	18.7 + 11.3 = 30	12.5	} 13.0
97.5	22.6 + 12.4 = 35	13.6	
99	25.5		

	LOG NORMAL			
50	14.0 + 6 = 20	13.7	7.2	
90	19.1 + 10.9 = 30	20.9	12.1	} 12.9
97.5	22.5 + 12.5 = 35	20.1	13.7	
98	23.0 + 12.0 = 35	18.2	13.2	
99	24.6	(20.5)		

TEH 0470397

DUP050083216

BRIDGEPORT (N=147) Air Pb = 1.76

PERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS	
50	17.2 + 2.8 = 20	5.6	4.6	
90	24.2 + 5.8 = 30	8.0	7.6	7.3
97.5	29.8 + 5.2 = 35	5.9	7.0	7.3
99	33.4	(7.0)		

	LOG BLOOD Pb PEARSON		
50	17.3 + 2.7 = 20	4.5	
90	24.0 + 6.0 = 30	7.8	7.5
97.5	29.6 + 5.4 = 35	7.2	7.5
99	33.5		

	LOG NORMAL			
50	17.6 + 2.4 = 20	4.9	4.2	
90	23.9 + 6.1 = 30	11.8	7.9	8.4
97.5	28.0 + 7.0 = 35	8.3	8.8	8.4
98	28.7 + 6.3 = 35	7.3	8.1	
99	30.6		(10.1)	

TEH 0470398

DUP050083217

HOUSTON (N=191) Air Pb = 0.85

PERCENTILE	BLOOD Pb PEARSON	LOG	LINEAR AQS	
50	12.7 + 7.3 = 20	19.4	8.1	
90	17.8 + 12.2 = 30	25.9	13.0	} 14.0
97.5	20.8 + 14.2 = 35	25.7	15.0	}
99	22.5	(25.8)		

	LOG BLOOD Pb PEARSON		
50	12.6 + 7.4 = 20	8.2	
90	18.0 + 12.0 = 30	12.8	} 13.7
97.5	21.2 + 13.8 = 35	14.6	}
99	23.0		

	LOG NORMAL			
50	12.6 + 7.4 = 20	20.0	8.2	
90	17.8 + 12.2 = 30	25.9	13.0	} 13.6
97.5	21.5 + 13.5 = 35	22.4	14.3	}
98	22.1 + 12.9 = 35	19.8	13.7	
99	23.8	(24.1)		

BRIDGEPORT (N = 147) Air Pb = 1.76

PERCENTILE	BLOOD Pb PEARSON
50	17.2
90	24.2
97.5	29.8
99	33.4

	LOG-BLOOD Pb PEARSON
50	17.3
90	24.0
97.5	29.6
99	33.5

	LOG NORMAL
50	17.6
90	23.9
97.5	28.0
98	28.7
99	30.6

TEH 0470400

DUP050083219

LOMBARD (N=208) Air Pb = 1.18

PERCENTILE	BLOOD Pb PEARSON
50	14.0
90	19.0
97.5	22.9
99	25.5

	LOG-BLOOD Pb PEARSON
50	14.1
90	18.7
97.5	22.6
99	25.5

	LOG NORMAL
50	14.0
90	19.1
97.5	22.5
98	23.0
99	24.6

TEH 0470401

DUP050083220

GREENWICH VILLAGE (N=140) Air Pb = 2.08

PERCENTILE	BLOOD Pb PEARSON
50	16.4
90	22.9
97.5	27.5
99	30.4

	LOG BLOOD Pb PEARSON
50	16.4
90	22.7
97.5	27.5
99	30.7

	LOG- NORMAL
50	16.6
90	22.7
97.5	26.8
98	27.5
99	29.4

TEH 0470402

DUP050083221

PORT WASHINGTON (N = 198) Air Pb = 1.13

BLOOD Pb

PERCENTILE	PEARSON
50	15.2
90	21.4
97.5	25.4
99	27.8

LOG BLOOD Pb

	PEARSON
50	15.3
90	21.1
97.5	25.2
99	27.8

LOG NORMAL

50	15.4
90	21.1
97.5	24.9
98	25.5
99	27.2

HOUSTON (N=191) Air Pb = 0.85

PERCENTILE	BLOOD Pb PEARSON
50	12.7
90	17.8
97.5	20.8
99	22.5

	LOG BLOOD Pb PEARSON
50	12.6
90	18.0
97.5	21.2
99	23.0

	LOG NORMAL
50	12.6
90	17.8
97.5	21.5
98	22.1
99	23.8

WASHINGTON, D.C. (N=219) Air Pb = 1.19

BLOOD Pb

PERCENTILE	PEARSON
50	19.2
90	26.0
97.5	29.6
99	31.4

LOG BLOOD Pb

	PEARSON
50	19.1
90	26.0
97.5	29.6
99	31.3

LOG NORMAL

50	19.1
90	25.7
97.5	30.1
98	30.7
99	32.7

TEH 0470405

DUP050083224

LOS ALAMOS - FEMALE (N=191) Air Pb = .17

	BLOOD Pb
PERCENTILE	PEARSON
50	15.2
90	20.3
97.5	23.8
99	26.0

	LOG BLOOD Pb
	PEARSON
50	15.2
90	20.3
97.5	23.9
99	26.3

	LOG NORMAL
50	15.0
90	20.6
97.5	24.3
98	24.9
99	26.6

TEH 0470406

DUP050083225

LOS ALAMOS - MALE (N=80) Air Pb = .17

BLOOD Pb

PERCENTILE	PEARSON
50	17.0
90	23.5
97.5	28.2
99	31.2

LOG BLOOD Pb

	PEARSON
50	16.9
90	23.4
97.5	28.3
99	31.3

	LOG NORMAL
50	17.2
90	23.2
97.5	27.2
98	27.8
99	29.6

TEH 0470407

DUP050083226

PASADENA (N = 193) Air Pb = 3.39

BLOOD Pb

PERCENTILE	PEARSON
50	17.5
90	25.0
97.5	29.9
99	32.8

LOG BLOOD Pb

	PEARSON
50	17.5
90	24.7
97.5	30.1
99	33.8

	LOG-NORMAL
50	17.5
90	24.9
97.5	30.0
98	30.8
99	33.2

TEH 0470408

DUP050083227

RITTENHOUSE (N = 136) Air Pb = 1.67

BLOOD Pb

PERCENTILE	PEARSON
50	20.4
90	29.5
97.5	35.6
99	39.4

LOG BLOOD Pb

	PEARSON
50	20.5
90	29.4
97.5	35.2
99	38.6

LOG NORMAL

50	20.5
90	29.3
97.5	35.4
98	36.4
99	39.2

TEH 0470409

DUP050083228

ARDMORE (N = 150) airPb = 1.15

BLOOD Pb

PERCENTILE	PEARSON
50	18.8
90	26.1
97.5	29.8
99	31.6

LOG BLOOD Pb

	PEARSON
50	18.7
90	26.2
97.5	30.3
99	32.4

LOG NORMAL

50	18.0
90	27.1
97.5	33.6
98	34.6
99	37.8

OKEANA (N = 162) Air Pb = .32

PERCENTILE	BLOOD Pb PEARSON
50	15.9
90	23.0
97.5	27.6
99	30.3

	LOG BLOOD Pb PEARSON
50	16.1
90	22.5
97.5	27.4
99	30.9

	LOG NORMAL
50	15.6
90	23.6
97.5	29.3
98	30.2
99	32.9

TEH 0470411

DUP050083230

1/15/77

SEVEN CITIES DATA

COMBINED BLOOD Pb DISTRIBUTION

$(\text{BLOOD Pb})^{.15}$ $\quad S = .05971$

AZAR MODEL

$\log \text{BloodPb} = 1.08423 + .2669 \log(A + 3.28)$

$A = 0 \Rightarrow \text{BloodPb} = 16.67$

adjust each blood Pb to $A = 0 \Rightarrow \text{BloodPb} = 15.77$ (50%)

$(\text{BLOOD Pb})^{.15}$ PERCENTILE	
90	.07376
97.5	.11883

		AQS
$(15.77^{.15} + .07376)^{\frac{1}{.15}}$	= 21.66	7.8
$(15.77^{.15} + .11883)^{\frac{1}{.15}}$	= 26.11	6.6
$(16.67^{.15} + .07376)^{\frac{1}{.15}}$	= 22.84	5.8
$(16.67^{.15} + .11883)^{\frac{1}{.15}}$	= 27.49	4.8

Log Blood Pb
PERCENTILE

90	.13839
97.5	.22323

	AQS
10** (log 15.77 + .13839) = 21.69	7.8
10** (log 15.77 + .22323) = 26.37	6.2
10** (log 16.67 + .13839) = 22.93	5.7
10** (log 16.67 + .22323) = 27.87	4.4

$(\text{BLOOD Pb})^{.15}$ Normal approximation
PERCENTILE

		AQS	
		$(15.77)^{.15}$	$(16.67)^{.15}$
90	.07655		
97.5	.11703		
98	.12264		

	AQS
$(15.77^{.15} + .07655)^{\frac{1}{.15}} = 21.92$	7.4
$(15.77^{.15} + .11703)^{\frac{1}{.15}} = 25.92$	6.8
$(15.77^{.15} + .12264)^{\frac{1}{.15}} = 26.52$	6.0
$(16.67^{.15} + .07655)^{\frac{1}{.15}} = 23.11$	5.4
$(16.67^{.15} + .11703)^{\frac{1}{.15}} = 27.29$	5.1
$(16.67^{.15} + .12264)^{\frac{1}{.15}} = 27.92$	4.4

SENSITIVITY ANALYSIS
$(\text{BLOOD Pb})^{.15}$ NORMAL APPROXIMATION

	BLOOD Pb			AIR Pb		
PERCENTILE	15.77	16.67	Δ	15.77	16.77	Δ
90	21.92	23.11	1.2	7.4	5.4	2.0
97.5	25.92	27.29	1.4	6.8	5.1	1.7
98	26.52	27.92	1.4	6.0	4.9	1.6
			1.33			1.77

$(\text{BLOOD Pb})^{.15}$ PEARSON FIT

90	21.66	22.84	1.2	7.8	5.8	2.0
97.5	26.11	27.49	1.4	6.6	4.8	1.8
			1.3			1.9

$$\text{SLOPE}_1 = \frac{1.77}{1.33} = 1.33$$

$$\text{SLOPE } 2 = \frac{1.9}{1.3} = 1.46$$

Conclude a blood Pb difference of 1 ug/100g results in an air Pb difference of 1.3 to 1.5 ug/m^3

DATA SET	A Air Pb	B ESTIMATED 50%	B-A
Azar (B-A)	0	15.7	15.7
Azar (C=3.28)	0	15.8	15.8
Okeana	.32	15.9	15.6
Ardmore	1.15	18.8	17.6
Rittenhouse	1.67	20.4	18.7
Pasadena	3.39	17.5	14.1
Los Alamos (M)	.17	17.0	16.8
Los Alamos (F)	.17	15.2	15.0
Wash DC	1.19	19.2	18.0
Pt Wash	1.13	15.2	14.1
Greenwich Village	2.08	16.4	14.3
Yonkers	1.18	14.0	12.8
Bridgeport	1.76	17.2	15.4
Houston	.85	12.7	11.9

♀ AVG = 15.2

AZAR AND SEVEN CITIES COMBINED
SUMMARY OF 50 PERCENTILE RESULTS

CASE I	BLOOD Pb	AQV	"AQV+3"
LOG MODEL	15.8	4.7	10.1 (23) 8.1 (22)
LINEAR MODEL	15.8	4.2	7.2

Results are the same as for the AZAR data because the effect of the 7 cities distribution is 0 at the 50 percentile (ie P_{50} is totally depent on the air Pb - blood Pb model).