CC: W. F. Wagner
R. D. Snee

December 7, 1983

TO: D. W. MARQUARDT
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FROM: C. G. PFEIFER CGP

BLOOD LEAD/GASOLINE LEAD DRAFT REPORT

In an informal seminar in September, I discussed our analyses of blood lead data from a four-year national survey (NHANES II). Our goal is to quantify the portion of a reported decline of 5-6 ug/dl in blood lead levels attributable to survey design and exposure to gasoline lead. Attached is a partial draft of a report that was recently sent to Dr. Ralph Bradley for review prior to a Dec. 15, 1983 meeting with him. Ron and I would welcome any comments you may have on this draft by the end of the year. The deadline for submission to EPA is January 15, 1984. Also attached is a copy of a Petroleum Laboratory report based on earlier results that will provide a quick overview of the problem.

Sections of the draft report are:

II. NHANES II and the Reported Blood Lead Decline

III. Effect of Survey Design on Reported Blood Lead Decline

IV. Gasoline Lead Exposure

V. Effect of Exposure to Gasoline Lead on Reported Blood Lead Decline

Also included are Appendices referenced in Sections III and V.

CGP:mai
Atch

TEH 0532551

N33828

```
MTB > >STOP

*** MINITAB *** STATISTICS DEPT * PENN STATE UNIV. * RELEASE 82.1 *
STORAGE USED        3000 STORAGE AVAILABLE 100000

MTB > >CORR C15 C16 C17 C30

                   T2X1 PRIMEX2 PRIME
X1 PRIME     -.899
X2 PRIME     -.679     .620
M2           -.980     .917     .776

MTB > >REGRESS C30 ON 3 PRED C16 C17 C15

THE REGRESSION EQUATION IS
M2 = 10.2 + 2.26 X1 PRIME + 3.19 X2 PRIME - 4.84 T2

                                  ST. DEV.     T-RATIO =
COLUMN        COEFFICIENT         OF COEF.     COEF/S.D.
                   10.204            2.932          3.48
X1 PRIME           2.2642           0.7696          2.94
X2 PRIME           3.1863           0.5545          5.75
T2                -4.8362           0.4429        -10.92

S = 4.672

R-SQUARED = 98.9 PERCENT
R-SQUARED = 98.7 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO        DF              SS       MS=SS/DF
REGRESSION      3           32553          10851
RESIDUAL       16             349             22
TOTAL          19           32902

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN
 DUE TO        DF              SS
REGRESSION      3           32553
X1 PRIME        1           27644
X2 PRIME        1            2307
T2              1            2602

                          Y      PRED. Y    ST.DEV.
 ROW X1 PRIME            M2        VALUE    PRED. Y   RESIDUAL      ST.RES.
  15     -8.0       -121.02      -112.32       2.04      -8.70      -2.07R

R DENOTES AN OBS. WITH A LARGE ST. RES.

DURBIN-WATSON STATISTIC = 1.25

MTB > >REGRESS C30 ON 2 PRED C16 C17

THE REGRESSION EQUATION IS
M2 = 18.6 + 9.24 X1 PRIME + 5.33 X2 PRIME

                                  ST. DEV.     T-RATIO =
COLUMN        COEFFICIENT         OF COEF.     COEF/S.D.
                   18.561            7.982          2.33
X1 PRIME            9.242            1.209          7.64
X2 PRIME            5.331            1.463          3.64
```

| | $\hat{\beta}_6$ |
|---|---|
| $X_1, X_2, T2$ | $-4.84$ |
| $T_2/X_1, X_2$ | $-0.81$ |
| $X_1$ ADJ, $X_2$ ADJ, T2 | $-6.90$ |

TEH 0532552

N33828.01

DUP050033821

```
R-SQUARED = 91.0 PERCENT
R-SQUARED = 90.0 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF          SS       MS=SS/DF
REGRESSION     2       29950          14975
RESIDUAL      17        2952            174
TOTAL         19       32902

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN
 DUE TO       DF          SS
REGRESSION     2       29950
X1 PRIME       1       27644
X2 PRIME       1        2307


DURBIN-WATSON STATISTIC = 1.70

MTB > >REGRESS C30 ON 2 PRED C16 C17 C31 C32

THE REGRESSION EQUATION IS
M2 = 18.6 + 9.24 X1 PRIME + 5.33 X2 PRIME

                                      ST. DEV.     T-RATIO =
COLUMN        COEFFICIENT             OF COEF.     COEF/S.D.
                   18.561               7.982          2.33
X1 PRIME            9.242               1.209          7.64
X2 PRIME            5.331               1.463          3.64

S = 13.18

R-SQUARED = 91.0 PERCENT
R-SQUARED = 90.0 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF          SS       MS=SS/DF
REGRESSION     2       29950          14975
RESIDUAL      17        2952            174
TOTAL         19       32902

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN
 DUE TO       DF          SS
REGRESSION     2       29950
X1 PRIME       1       27644
X2 PRIME       1        2307


DURBIN-WATSON STATISTIC = 1.70

MTB > >NAME C31 'STRES M2',C32 'PRED M2'
MTB > >LET C33=C30-C32
MTB > >NAME C33 'M2 RES'
MTB > >REGRESS C33 ON 1 PRED C15

THE REGRESSION EQUATION IS
M2 RES = 8.50 - 0.809 T2
```

TEH 0532553

DUP050033822

| COLUMN | COEFFICIENT | ST. DEV. OF COEF. | T-RATIO = COEF/S.D. |
|---|---|---|---|
| | 8.496 | 5.492 | 1.55 |
| T2 | -0.8091 | 0.4585 | -1.76 |

S = 11.82

R-SQUARED = 14.8 PERCENT
R-SQUARED = 10.0 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

| DUE TO | DF | SS | MS=SS/DF |
|---|---|---|---|
| REGRESSION | 1 | 435.4 | 435.4 |
| RESIDUAL | 18 | 2516.2 | 139.8 |
| TOTAL | 19 | 2951.6 | |

DURBIN-WATSON STATISTIC = 1.59

MTB > >REGRESS C30 ON 2 PRED C26 C27

THE REGRESSION EQUATION IS
M2 = - 74.9 - 3.1 X1P RES + 6.7 SRES X2P

| COLUMN | COEFFICIENT | ST. DEV. OF COEF. | T-RATIO = COEF/S.D. |
|---|---|---|---|
| | -74.935 | 9.669 | -7.75 |
| X1P RES | -3.11 | 18.20 | -0.17 |
| SRES X2P | 6.72 | 10.46 | 0.64 |

S = 43.24

R-SQUARED = 3.4 PERCENT
R-SQUARED = .0 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

| DUE TO | DF | SS | MS=SS/DF |
|---|---|---|---|
| REGRESSION | 2 | 1117 | 558 |
| RESIDUAL | 17 | 31785 | 1870 |
| TOTAL | 19 | 32902 | |

CONTINUE? > ANALYSIS OF VARIANCE
[illegible] BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN
[illegible] ORDER GIVEN [illegible] 82.1 *

C30 y
C26 X1 Res
C29 X2 Res
C15 T2

TEH 0532554

DUP050033823

```
>@MINITAB*MINITAB.MINITAB

IF YOU NEED THE 81.1 VERSION OF MINITAB, IT IS IN "OLD*MINITAB.MINITAB".
MINITAB RELEASE 82.1 *** COPYRIGHT - PENN STATE UNIV. 1982
FEB.  9, 1984 *** UNIV. OF WISCONSIN - MADISON -- MACC VERSION 82.1-UW2.1

STORAGE AVAILABLE 100000

MTB > >RETR 'CAKRDS*TESTS.'
MTB > >INFO

COLUMN     NAME       COUNT
C1         T            20
C2         X1           20
C3         X2           20
C4         E            20
C5         M            20
C6         Y RESID      20
C7         ST RESID     20
C8         PRED Y       20
C9         ST X1        20
C10        PRED X1      20
C11        ST X2        20
C12        PRED X2      20
C13        X1 RESID     20
C14        X2 RESID     20
C15        T2           20
C16        X1 PRIME     20
C17        X2 PRIME     20
C18        M PRIME      20
C19        E1           20
C20        M+E1         20
C21        STRES MP     20
CONTINUE? >
C22        PRED MP      20
C23        RESID MP     20
C24        SRES X1P     20
C25        PRE X1P      20
C26        X1P RES      20
C27        SRES X2P     20
C28        PRE X2P      20
C29        X2P RES      20
C30        M2           20
C31        STRES M2     20
C32        PRED M2      20
C33        M2 RES       20

CONSTANTS USED: K1     K49    K50

MTB > >REGRESS C16 ON 1 PRED C15 C34 C35

THE REGRESSION EQUATION IS
X1 PRIME = - 1.52 - 0.484 T2
```

```
COLUMN       COEFFICIENT          OF COEF.    COEF/S.D.
                -1.5158            0.6650       -2.28
T2             -0.48421           0.05551       -8.72

S = 1.431

R-SQUARED = 80.9 PERCENT
R-SQUARED = 79.8 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF          SS        MS=SS/DF
REGRESSION     1      155.92          155.92
RESIDUAL      18       36.88            2.05
TOTAL         19      192.80


DURBIN-WATSON STATISTIC = 1.74

MTB > >NAME C34 'STRESX1P',C35 'PRED X1P'
MTB > >LET C36=C16-C35
MTB > >NAME C36 'X1P RES2'
MTB > >REGRESS C17 ON 1 PRED C15 C37 C38

THE REGRESSION EQUATION IS
X2 PRIME = - 2.93 - 0.302 T2

                                   ST. DEV.    T-RATIO =
COLUMN       COEFFICIENT          OF COEF.    COEF/S.D.
                -2.9263            0.9229       -3.17
T2             -0.30226           0.07704       -3.92

S = 1.987

R-SQUARED = 46.1 PERCENT
R-SQUARED = 43.1 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF          SS        MS=SS/DF
REGRESSION     1      60.753          60.753
RESIDUAL      18      71.047           3.947
TOTAL         19     131.800


DURBIN-WATSON STATISTIC = 2.95

MTB > >NAME C37 'STRESX2P',C38 'PRED X2P'
MTB > >LET C39=C17-C38
MTB > >NAME C39 'X2P RES2'
MTB > >CORR C15 C36 C39 C30

                 T2X1P RES2X2P RES2
X1P RES2     .000
X2P RES2     .000      .029
M2          -.980      .080     .150

MTB > >REGRESS C30 ON 3 PRED C36 C39 C15

THE REGRESSION EQUATION IS
M2 = - 2.55 + 2.26 X1P RES2 + 3.19 X2P RES2 - 6.90 T2

                                   ST. DEV.    T-RATIO =
COLUMN       COEFFICIENT          OF COEF.    COEF/S.D.
```

```
                    -2.552           2.170        -1.18
X1P RES2            2.2642           0.7696        2.94
X2P RES2            3.1863           0.5545        5.75
T2                 -6.8957           0.1812      -38.06

S = 4.672

R-SQUARED = 98.9 PERCENT
R-SQUARED = 98.7 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF           SS      MS=SS/DF
REGRESSION     3        32553         10851
RESIDUAL      16          349            22
TOTAL         19        32902

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN
 DUE TO       DF           SS
REGRESSION     3        32553
X1P RES2       1          211
X2P RES2       1          721
T2             1        31621

                           Y     PRED. Y   ST.DEV.
 ROW X1P RES2             M2       VALUE   PRED. Y   RESIDUAL    ST.RES.
  15      0.78       -121.02     -112.32      2.04      -8.70     -2.07R

R DENOTES AN OBS. WITH A LARGE ST. RES.

DURBIN-WATSON STATISTIC = 1.25

MTB > >SAVE 'CAKRDS*TESTS.'
MTB > >STOP

*** MINITAB *** STATISTICS DEPT * PENN STATE UNIV. * RELEASE 82.1 *
STORAGE USED        3000 STORAGE AVAILABLE 100000
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TEH 0532557

```
MTB > >STOP

*** MINITAB *** STATISTICS DEPT * PENN STATE UNIV. * RELEASE 82.1 *
STORAGE USED        3000 STORAGE AVAILABLE 100000

MTB > >REGRESS C18 ON 3 PRED C16 C17 C1

THE REGRESSION EQUATION IS
M PRIME = 7.17 - 0.06 X1 PRIME + 2.80 X2 PRIME - 6.23 T

                                ST. DEV.     T-RATIO =
COLUMN       COEFFICIENT        OF COEF.     COEF/S.D.
                   7.166           3.670          1.95
X1 PRIME          -0.058           1.897         -0.03
X2 PRIME          2.8012          0.5729          4.89
T                 -6.230           1.092         -5.71

S = 4.516

R-SQUARED = 99.0 PERCENT
R-SQUARED = 98.9 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF           SS        MS=SS/DF
REGRESSION     3        33577           11192
RESIDUAL      16          326              20
TOTAL         19        33903

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN
 DUE TO       DF           SS
REGRESSION     3        33577
X1 PRIME       1        31353
X2 PRIME       1         1560
T              1          664


DURBIN-WATSON STATISTIC = 1.34

MTB > >CORR C16 C17 C1 C18

              X1 PRIMEX2 PRIME          T
X2 PRIME        .620
T              -.983       -.679
M PRIME         .962        .764      -.987

MTB > >REGRESS C18 ON 2 PRED C16 C17 C19 C20

THE REGRESSION EQUATION IS
M PRIME = 21.1 + 10.5 X1 PRIME + 4.38 X2 PRIME

                                ST. DEV.     T-RATIO =
COLUMN       COEFFICIENT        OF COEF.     COEF/S.D.
                  21.122           4.623          4.57
X1 PRIME         10.5057          0.7004         15.00
X2 PRIME          4.3838          0.8472          5.17

S = 7.633

R-SQUARED = 97.1 PERCENT
R-SQUARED = 96.7 PERCENT, ADJUSTED FOR D.F.
```

$\beta_t = -5$

| | $\hat{\beta}_t$ |
|---|---|
| $x_1, x_2, t$ | $-6.23$ |
| $\hat{y}(x_1,x_2)$ vs $T$ | $-0.16$ |
| $x_1$RES, $x_2$RES, $T$ | $-7.05$ |

$VIF \geq \frac{1}{1-.983^2} = \underline{\underline{29.66}}$

.985

.969

TEH 0532558

DUP050033827

```
ANALYSIS OF VARIANCE

 DUE TO       DF           SS        MS=SS/DF
REGRESSION     2        32913          16456
RESIDUAL      17          990             58
TOTAL         19        33903

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN
 DUE TO       DF           SS
REGRESSION     2        32913
X1 PRIME       1        31353
X2 PRIME       1         1560

                              Y   PRED. Y   ST.DEV.
 ROW X1 PRIME    M PRIME     VALUE   PRED. Y   RESIDUAL      ST.RES.
  14     -8.0     -96.28    -80.46      3.03     -15.83       -2.26R
  15     -8.0    -121.02   -106.76      3.28     -14.26       -2.07R

R DENOTES AN OBS. WITH A LARGE ST. RES.

DURBIN-WATSON STATISTIC = 1.64

MTB > >NAME C19 'ST M PR',C20 'PRE M PR'
MTB > >INFO

COLUMN      NAME        COUNT
C1          T              20
C2          X1             20
C3          X2             20
C4          E              20
C5          M              20
C6          Y RESID        20
C7          ST RESID       20
C8          PRED Y         20
C9          ST X1          20
C10         PRED X1        20
C11         ST X2          20
C12         PRED X2        20
C13         X1 RESID       20
C14         X2 RESID       20
C15         T2             20
C16         X1 PRIME       20
C17         X2 PRIME       20
C18         M PRIME        20
C19         ST M PR        20
C20         PRE M PR       20

CONTINUE? >
CONSTANTS USED: K1    K49   K50

MTB > >LET C21=C18-C20
MTB > >NAME C21 'M PR RES'
MTB > >REGRESS C21 ON 1 PRED C1

THE REGRESSION EQUATION IS
M PR RES = 1.68 - 0.160 T
                                         ST. DEV.     T-RATIO =
COLUMN        COEFFICIENT                OF COEF.     COEF/S.D.
                    1.683                  3.416          0.49
T                 -0.1603                 0.2851         -0.56

S = 7.353
```

TEH 0532559

DUP050033828

```
R-SQUARED =  1.7 PERCENT
R-SQUARED =   .0 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO      DF          SS        MS=SS/DF
REGRESSION    1        17.08          17.08
RESIDUAL     18       973.26          54.07
TOTAL        19       990.34

CONTINUE? >
                          Y    PRED. Y    ST.DEV.
 ROW         T   M PR RES      VALUE    PRED. Y   RESIDUAL      ST.RES.
  14      14.0    -15.83       -0.56       1.92     -15.26       -2.15R

R DENOTES AN OBS. WITH A LARGE ST. RES.

DURBIN-WATSON STATISTIC = 1.67

MTB > >INFO

COLUMN     NAME        COUNT
C1         T              20
C2         X1             20
C3         X2             20
C4         E              20
C5         M              20
C6         Y RESID        20
C7         ST RESID       20
C8         PRED Y         20
C9         ST X1          20
C10        PRED X1        20
C11        ST X2          20
C12        PRED X2        20
C13        X1 RESID       20
C14        X2 RESID       20
C15        T2             20
C16        X1 PRIME       20
C17        X2 PRIME       20
C18        M PRIME        20
C19        ST M PR        20
C20        PRE M PR       20
C21        M PR RES       20
CONTINUE? >

CONSTANTS USED: K1     K49    K50

MTB > >REGRESS C16 ON 1 PRED C1 C22 C23

THE REGRESSION EQUATION IS
X1 PRIME = - 1.04 - 0.529 T

                                     ST. DEV.    T-RATIO =
COLUMN       COEFFICIENT             OF COEF.    COEF/S.D.
                 -1.0421              0.2787       -3.74
T               -0.52932             0.02326      -22.75

S = 0.5999

R-SQUARED = 96.6 PERCENT
R-SQUARED = 96.5 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO      DF          SS        MS=SS/DF
```

```
RESIDUAL     18          6.48           0.36
TOTAL        19        192.80


DURBIN-WATSON STATISTIC = 2.27

MTB > >REGRESS C17 ON 1 PRED C1 C24 C25

THE REGRESSION EQUATION IS
X2 PRIME = - 2.93 - 0.302 T

                                        ST. DEV.     T-RATIO =
COLUMN         COEFFICIENT              OF COEF.     COEF/S.D.
                  -2.9263                0.9229        -3.17
T                 -0.30226               0.07704       -3.92

S = 1.987

R-SQUARED = 46.1 PERCENT
R-SQUARED = 43.1 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO        DF            SS        MS=SS/DF
REGRESSION      1        60.753         60.753
RESIDUAL       18        71.047          3.947
TOTAL          19       131.800


DURBIN-WATSON STATISTIC = 2.88

MTB > >NAME C22 'ST X1PR',C23 'PRED X1P',C24 'ST X2PR',C25 'PRED X2P'
MTB > >LET C26=C16-C23
MTB > >LET C27=C17-C25
MTB > >NAME C26 'X1P RES',C27 'X2P RES'
MTB > >INFO

COLUMN      NAME         COUNT
C1          T               20
C2          X1              20
C3          X2              20
C4          E               20
C5          M               20
C6          Y RESID         20
C7          ST RESID        20
C8          PRED Y          20
C9          ST X1           20
C10         PRED X1         20
C11         ST X2           20
C12         PRED X2         20
C13         X1 RESID        20
C14         X2 RESID        20
C15         T2              20
C16         X1 PRIME        20
C17         X2 PRIME        20
C18         M PRIME         20
C19         ST M PR         20
C20         PRE M PR        20
C21         M PR RES        20
CONTINUE? >
C22         ST X1PR         20
C23         PRED X1P        20
C24         ST X2PR         20
```

```
C26        X1P RES      20
C27        X2P RES      20

CONSTANTS USED: K1     K49     K50

MTB > >REGRESS C18 ON 3 PRED C26 C27 C1

THE REGRESSION EQUATION IS
M PRIME = - 0.97 - 0.06 X1P RES + 2.80 X2P RES - 7.05 T

                                      ST. DEV.     T-RATIO =
COLUMN       COEFFICIENT              OF COEF.     COEF/S.D.
                  -0.971                2.098        -0.46
X1P RES           -0.058                1.897        -0.03
X2P RES           2.8012               0.5729         4.89
T                -7.0462               0.1751       -40.23

S = 4.516

R-SQUARED = 99.0 PERCENT
R-SQUARED = 98.9 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF           SS       MS=SS/DF
REGRESSION     3        33577          11192
RESIDUAL      16          326             20
TOTAL         19        33903

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN
 DUE TO       DF           SS
REGRESSION     3        33577
X1P RES        1           72
X2P RES        1          488
T              1        33017


DURBIN-WATSON STATISTIC = 1.34
```

Depend. Var. ln BP

Time Coeff.

| | | |
|---|---|---|
| – Residual | –.0000816 | |
| – Time w/X's | –.0002690 | 230.7% |
| – Ridge (K=.5) | –.0001410 | 72.8% |

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 t$$

$$X_1 = \alpha_1 + \alpha_2 t$$

$$X_2 = \theta_1 + \theta_2 t$$

7.17

$$y = \beta_0 + \beta_1 (X_1 - \alpha_1 - \alpha_2 t)$$

$$+ \beta_2 (X_2 - \theta_1 - \theta_2 t)$$

$$+ \beta_3 t$$

$$= (\beta_0 - \alpha_1 \beta_1 - \theta_2 \beta_2)$$

$$+ \beta_1 X_1$$

$$+ \beta_2 X_2$$

$$+ (\beta_3 - \alpha_2 - \theta_2)\, t$$

$$\|$$

$$(-6.23 + .529 + .302)$$

~~.529(.06) = .03174~~

~~(2.80) = .8456~~

~~.87734~~

$-1.04(.06) = .0624$

$-2.93(2.80)$ 8.204

8.2664

.529

.302

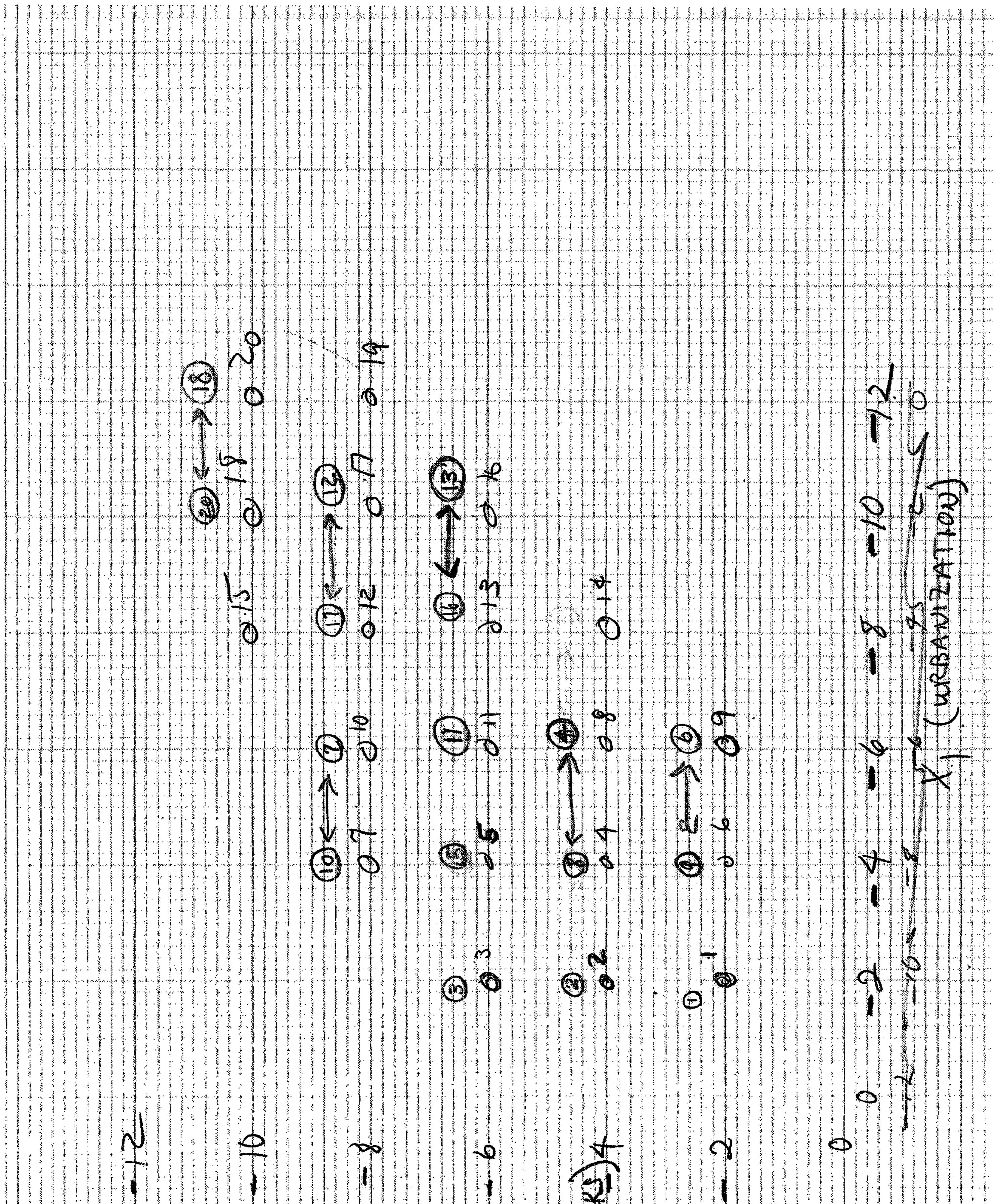
.831

6.23

7.061

TEH 0532564

DUP050033833



$X_2$ (BLACKS)
$X_1$ (URBANIZATION)
0
2
4
6
8
10
12

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 t + \epsilon$$

$$X_1 = \alpha_1 + \alpha_2 t$$

$$X_2 = \theta_1 + \theta_2 t$$

$$M = 10 + 2X_1 + 3X_2 \overset{-}{+} .5t + \epsilon$$

$$\cancel{X_1 = 1 + 2t}$$

$$\cancel{X_2 = 3 + 7t}$$

$$\cancel{X_1 = 2 + 3X_2}$$

24
30
100
10
~~164~~

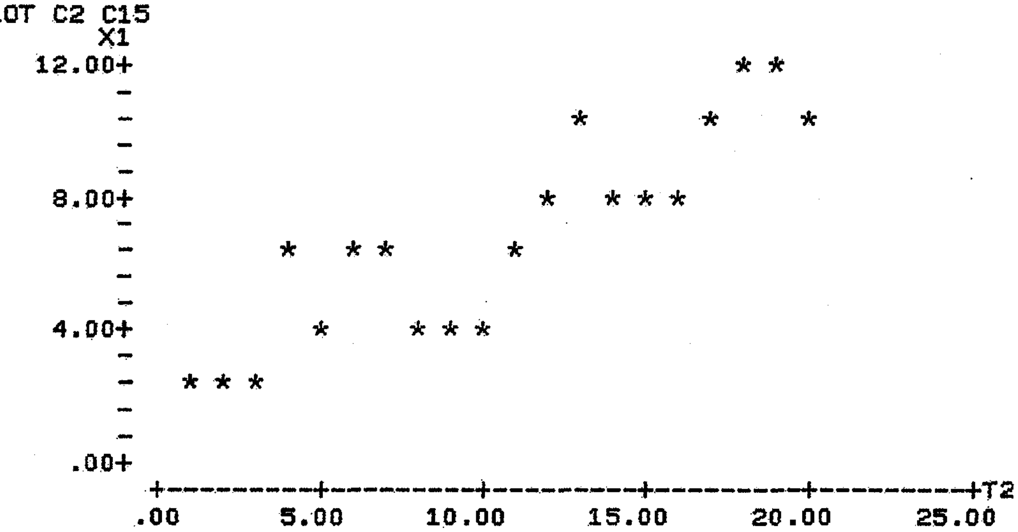
$M = 25$ —

$\sigma = 5$

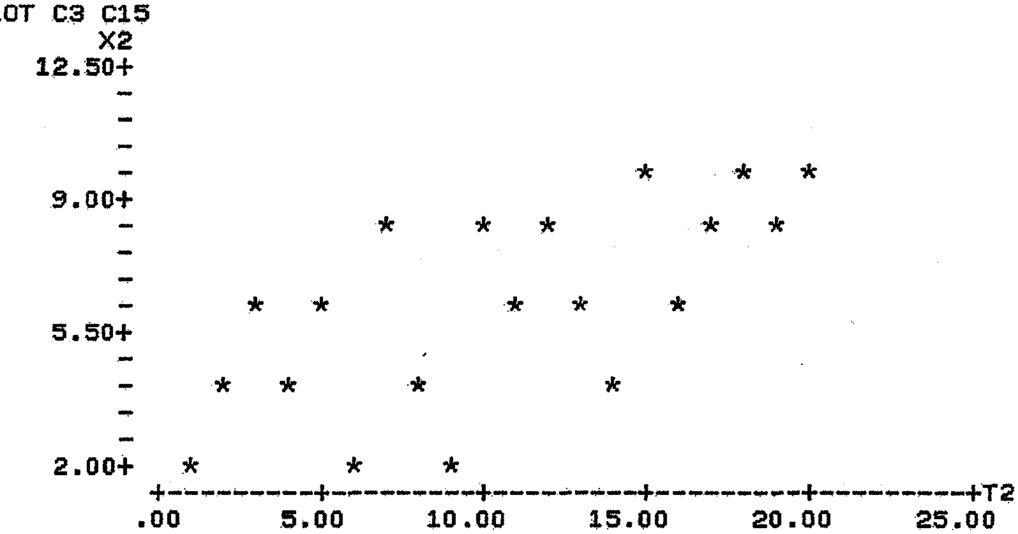
TEH 0532566

DUP050033835

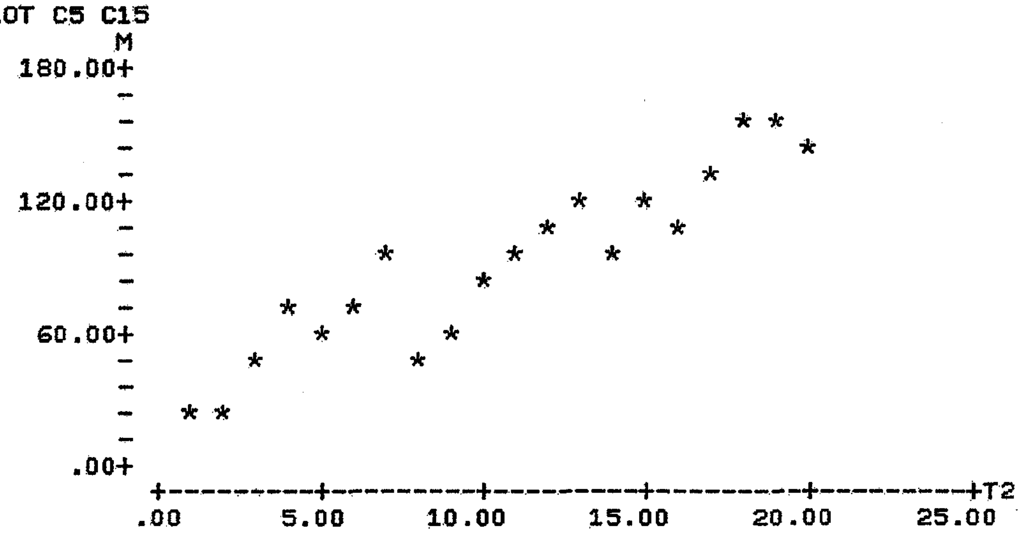
MTB > >PLOT C2 C15




MTB > >PLOT C3 C15




MTB > >PLOT C5 C15




TEH 0532567

DUP050033836

```
MTB > >PLOT C3 C2
                  X2
              12.50+
                   -
                   -
                   -
                   -                                       *          *          *
               9.00+
                   -          *          *          *          *          *
                   -
                   -
                   -  *       *          *          *          *
               5.50+
                   -
                   -  *       *          *          *
                   -
                   -
               2.00+  *       *          *
                      +----------+---------+---------+---------+---------+X1
                    2.00       4.00      6.00      8.00     10.00     12.00
```

```
MTB > >CORR C15 C2 C3 C5

                T2        X1        X2
X1             .899
X2             .679      .620
M              .930      .969      .764
```

$$VIF = \frac{1}{1-.8} = \frac{1}{.2} = \frac{1}{2/10} = \underline{\underline{5}}$$

```
MTB > >REGRESS C5 ON 3 PRED C2 C3 C15

THE REGRESSION EQUATION IS
M = 0.63 + 8.85 X1 + 3.67 X2 + 1.11 T2

                                      ST. DEV.      T-RATIO =
COLUMN          COEFFICIENT           OF COEF.      COEF/S.D.
                      0.632              3.266           0.19
X1                   8.8536             0.8572          10.33
X2                   3.6658             0.6177           5.94
T2                   1.1063             0.4934           2.24

S = 5.204

R-SQUARED = 98.7 PERCENT
R-SQUARED = 98.4 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO        DF            SS        MS=SS/DF
REGRESSION      3         32049           10683
RESIDUAL       16           433              27
TOTAL          19         32482

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN
 DUE TO        DF            SS
REGRESSION      3         32049
X1              1         30511
X2              1          1402
T2              1           136

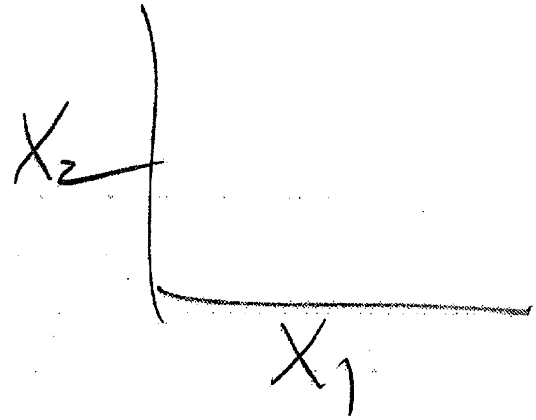
                                 Y      PRED. Y     ST.DEV.
 ROW           X1                M        VALUE     PRED. Y     RESIDUAL      ST.RES.
```

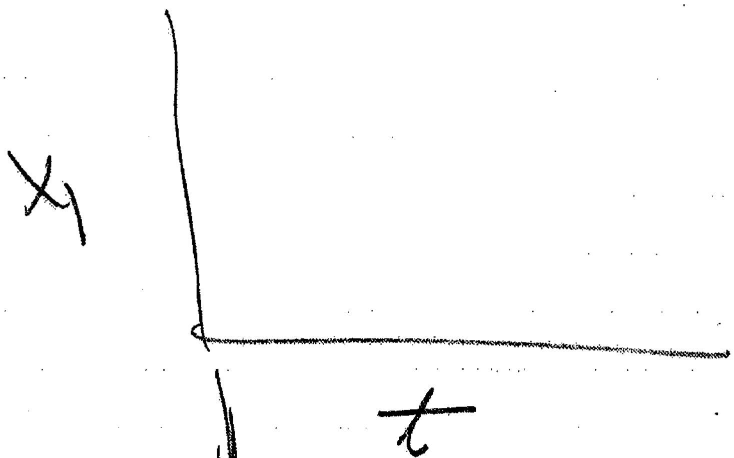
TEH 0532568

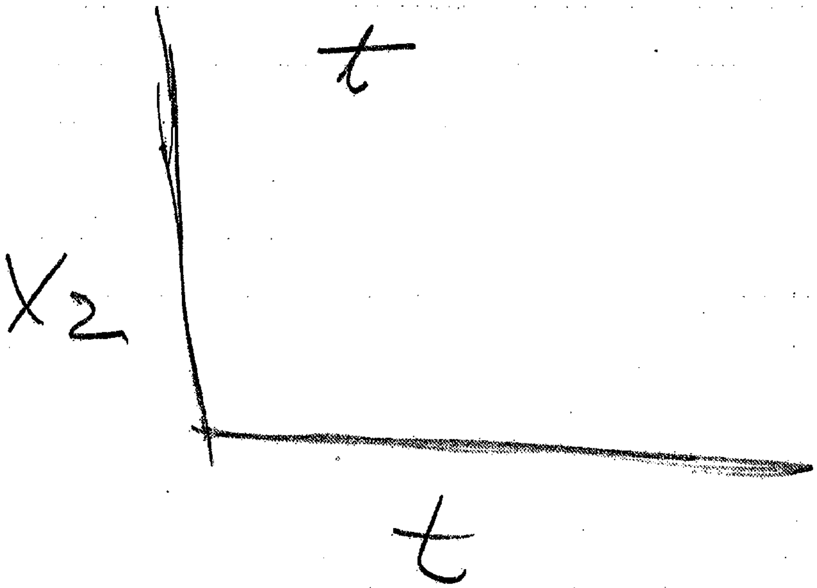
DUP050033837

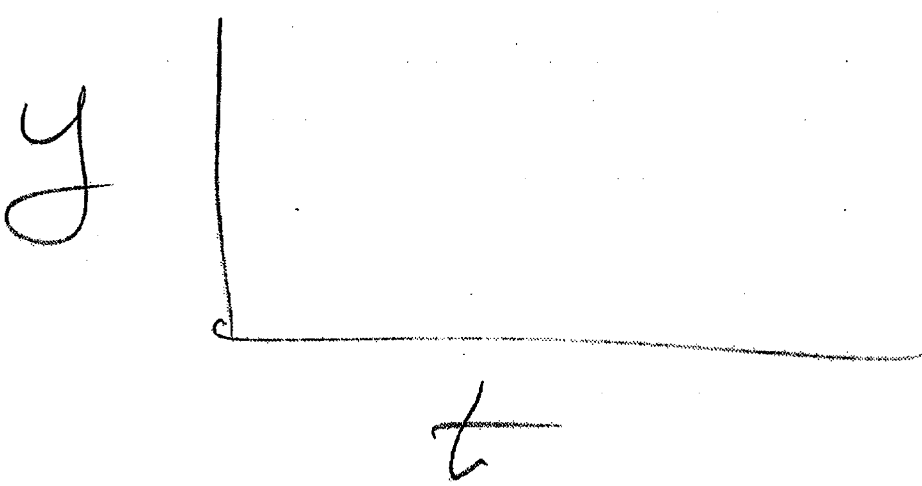
```
R DENOTES AN OBS. WITH A LARGE ST. RES.
DURBIN-WATSON STATISTIC = 1.17
MTB > >SAVE 'CAKRDS*TESTS.'
```

TEH 0532569


$X_2$
$X_1$


$X_1$
$t$


$X_2$
$t$


$y$
$t$

$Y = M + \epsilon$

[illegible]

| t | $X_1$ | $X_2$ |
|---|---|---|
| 1 | 2 | 2 |
| 2 | 2 | 4 |
| 3 | 2 | 6 |
| 4 | 4 | 4 |
| 5 | 4 | 6 |
| 6 | 4 | 2 |
| 7 | 4 | 8 |
| 8 | 6 | 4 |
| 9 | 6 | 2 |
| 10 | 6 | 8 |
| 11 | 6 | 6 |
| 12 | 8 | 8 |
| 13 | 8 | 6 |
| 14 | 8 | 4 |
| 15 | 8 | 10 |
| 16 | 10 | 6 |
| 17 | 10 | 8 |
| 18 | 10 | 10 |
| 19 | 12 | 8 |
| 20 | 12 | 10 |

TEH 0532573

MTB > >REGRESS C5 ON 3 PRED C2 C3 C1

DUP050033841

THE REGRESSION EQUATION IS
M = 7.17 + 4.06 X1 + 3.20 X2 + 3.77 T

2 3 5

| COLUMN | COEFFICIENT | ST. DEV. OF COEF. | T-RATIO = COEF/S.D. |
|---|---|---|---|
| | 7.166 | 3.670 | 1.95 |
| X1 | 4.058 | 1.897 | 2.14 |
| X2 | 3.1988 | 0.5729 | 5.58 |
| T | 3.770 | 1.092 | 3.45 |

S = 4.516

R-SQUARED = 99.0 PERCENT
R-SQUARED = 98.8 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

| DUE TO | DF | SS | MS=SS/DF |
|---|---|---|---|
| REGRESSION | 3 | 32156 | 10719 |
| RESIDUAL | 16 | 326 | 20 |
| TOTAL | 19 | 32482 | |

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN

| DUE TO | DF | SS |
|---|---|---|
| REGRESSION | 3 | 32156 |
| X1 | 1 | 30511 |
| X2 | 1 | 1402 |
| T | 1 | 243 |

DURBIN-WATSON STATISTIC = 1.34

MTB > >REGRESS C5 ON 2 PRED C2 C3

THE REGRESSION EQUATION IS
M = - 1.28 + 10.4 X1 + 4.16 X2

| COLUMN | COEFFICIENT | ST. DEV. OF COEF. | T-RATIO = COEF/S.D. |
|---|---|---|---|
| | -1.279 | 3.506 | -0.36 |
| X1 | 10.4498 | 0.5312 | 19.67 |
| X2 | 4.1564 | 0.6424 | 6.47 |

S = 5.788

R-SQUARED = 98.2 PERCENT
R-SQUARED = 98.0 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

| DUE TO | DF | SS | MS=SS/DF |
|---|---|---|---|
| REGRESSION | 2 | 31913 | 15956 |
| RESIDUAL | 17 | 569 | 33 |
| TOTAL | 19 | 32482 | |

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN

| DUE TO | DF | SS |
|---|---|---|
| REGRESSION | 2 | 31913 |
| X1 | 1 | 30511 |
| X2 | 1 | 1402 |

TEH 0532574

DUP050033842

```
DURBIN-WATSON STATISTIC = 1.81

MTB > >REGRESS C5 ON 2 PRED C2 C3 C7 C8

THE REGRESSION EQUATION IS
M = - 1.28 + 10.4 X1 + 4.16 X2

                                      ST. DEV.     T-RATIO =
COLUMN        COEFFICIENT             OF COEF.     COEF/S.D.
                  -1.279               3.506         -0.36
X1               10.4498               0.5312        19.67
X2                4.1564               0.6424         6.47

S = 5.788

R-SQUARED = 98.2 PERCENT
R-SQUARED = 98.0 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF           SS        MS=SS/DF
REGRESSION     2        31913           15956
RESIDUAL      17          569              33
TOTAL         19        32482

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN
 DUE TO       DF           SS
REGRESSION     2        31913
X1             1        30511
X2             1         1402


DURBIN-WATSON STATISTIC = 1.81

MTB > >LET C6=C5-C8
MTB > >NAME C6 'Y RESID'
MTB > >REGRESS C6 ON 1 PRED C1

THE REGRESSION EQUATION IS
Y RESID = - 1.02 + 0.097 T

                                      ST. DEV.     T-RATIO =
COLUMN        COEFFICIENT             OF COEF.     COEF/S.D.
                  -1.018               2.598         -0.39
T                 0.0970               0.2169         0.45

S = 5.594

R-SQUARED =  1.1 PERCENT
R-SQUARED =   .0 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF           SS        MS=SS/DF
REGRESSION     1         6.25            6.25
RESIDUAL      18       563.22           31.29
TOTAL         19       569.48
```

TEH 0532575

DURBIN-WATSON STATISTIC = 1.[illegible]

DUP050033843

MTB > >NAME C7 'ST RESID',C8 'PRED Y'
MTB > >PRINT C1-C8

| ROW | T | X1 | X2 | E | M | Y RESID | ST RESID | PRED Y |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 2 | -0.7534 | 24.247 | -3.68651 | -0.71087 | 27.933 |
| 2 | 2 | 2 | 4 | -7.4820 | 28.518 | -7.72786 | -1.45731 | 36.246 |
| 3 | 3 | 2 | 6 | -1.3071 | 45.693 | 1.13428 | 0.22226 | 44.559 |
| 4 | 8 ~~4~~ | 4 | 4 | 1.4994 | 51.499 | -5.64616 | -1.02394 | 57.146 |
| 5 | 5 | 4 | 6 | -2.9768 | 58.023 | -7.43510 | -1.35695 | 65.458 |
| 6 | 9 ~~6~~ | 4 | 2 | 2.5257 | 56.526 | 7.69290 | 1.46730 | 48.833 |
| 7 | 10 ~~7~~ | 4 | 8 | 3.5950 | 80.595 | 6.82393 | 1.32969 | 73.771 |
| 8 | 4 ~~8~~ | 6 | 4 | -1.7794 | 72.221 | -5.82468 | -1.05581 | 78.045 |
| 9 | 6 ~~9~~ | 6 | 2 | 3.5611 | 76.561 | 6.82856 | 1.34372 | 69.733 |
| 10 | 7 ~~10~~ | 6 | 8 | 4.1898 | 100.190 | 5.51902 | 1.01186 | 94.671 |
| 11 | 11 | 6 | 6 | -0.2868 | 94.713 | 8.35525 | 1.48297 | 86.358 |
| 12 | 12 | 8 | 8 | 3.2994 | 113.299 | -2.27098 | -0.40850 | 115.570 |
| 13 | 16 ~~13~~ | 8 | 6 | 4.1078 | 113.108 | 5.85014 | 1.04722 | 107.258 |
| 14 | 14 | 8 | 4 | -8.2845 | 99.715 | 0.77053 | 0.14508 | 98.945 |
| 15 | 15 | 8 | 10 | -10.0171 | 120.983 | -2.90030 | -0.55506 | 123.883 |
| 16 | 13 ~~16~~ | 10 | 6 | -5.3341 | 122.666 | -5.49145 | -1.03019 | 128.157 |
| 17 | 17 | 10 | 8 | -3.7320 | 135.268 | -1.20207 | -0.22019 | 136.470 |
| 18 | 20 ~~18~~ | 10 | 10 | -0.3987 | 149.601 | 4.81847 | 0.91234 | 144.783 |
| 19 | 19 | 12 | 8 | 2.6184 | 155.618 | -1.75138 | -0.34056 | 157.370 |
| 20 | 18 ~~20~~ | 12 | 10 | -2.1740 | 161.826 | -3.85658 | -0.75305 | 165.683 |

MTB > >PLOT C2 C1

```
                X1
           12.00+                                     * *
                -
                -                               * * *
                -
                -
            8.00+                       * * * *
                -
                -               * * * *
                -
                -
            4.00+       * * * *
                -
                -   * * *
                -
                -
             .00+
                +---------+---------+---------+---------+---------+T
               .00      5.00     10.00     15.00     20.00     25.00
```

MTB > >PLOT C3 C1

```
                X2
           12.50+
                -
                -
                -
                -                             *     *   *
            9.00+
                -             *     *   *         *   *
                -
                -
                -     *   *           *   *     *
            5.50+
                -
                -   *   *       *           *
                -
                -
            2.00+ *         *     *
```

TEH 0532576

DUP050033844

```
                  +---------+---------+---------+---------+---------+T
                 .00      5.00     10.00     15.00     20.00     25.00

MTB > >PLOT C5 C1
                M
          180.00+
                -
                -                                       * *
                -                                     *
                -                                   *
          120.00+                               * *
                -                         * *
                -                     * *     *
                -               *
                -                 * *
           60.00+           * *
                -       * *
                -
                -   * *
                -
             .00+
                  +---------+---------+---------+---------+---------+T
                 .00      5.00     10.00     15.00     20.00     25.00

MTB > >PLOT C3 C2
               X2
           12.50+
                -
                -
                -
                -                              *         *         *
            9.00+
                -          *         *         *         *         *
                -
                -
                - *        *         *         *         *
            5.50+
                -
                - *        *         *         *
                -
                -
            2.00+ *        *         *
                  +---------+---------+---------+---------+---------+X1
                2.00      4.00      6.00      8.00     10.00     12.00

MTB > >CORR C1 C2 C3 C5

               T      X1      X2
X1          .983
X2          .679    .620
M           .985    .969    .764

MTB > >SAVE 'CAKRDS*TESTS.'
MTB > >STOP

*** MINITAB *** STATISTICS DEPT * PENN STATE UNIV. * RELEASE 82.1 *
STORAGE USED        3000 STORAGE AVAILABLE 100000
```

TEH 0532577

DUP050033845

```
  RUNID: CAK        ACCT: 156015          PROJECT: Q$Q$Q$
      CAK      FIN
  TIME:     TOTAL: 00:00:13.061        CBSUPS:  004956066
            CPU:   00:00:01.206        I/O:  00:00:06.155
            CC/ER: 00:00:05.698        WAIT: 00:17:02.879

  SUAS USED:           257    SUAS REMAINING:     99995983
  IMAGES  READ:    40          PAGES:   9
  START:     11:09:37 FEB 08,1984     FIN:  11:26:53 FEB 08,1984
*TERMINAL INACTIVE*
>@MINITAB*MINITAB.MINITAB

*WAIT-LAST INPUT IGNORED*

IF YOU NEED THE 81.1 VERSION OF MINITAB, IT IS IN "OLD*MINITAB.MINITAB".
MINITAB RELEASE 82.1 *** COPYRIGHT - PENN STATE UNIV. 1982
FEB.  8, 1984 *** UNIV. OF WISCONSIN - MADISON -- MACC VERSION 82.1-UW2.1
STORAGE AVAILABLE 100000

MTB > >RETR 'CAKRDS*TESTS.'
MTB > >INFO

COLUMN     NAME       COUNT
C1         T            20
C2         X1           20
C3         X2           20
C4         E            20
C5         M            20
C6         Y RESID      20
C7         ST RESID     20
C8         PRED Y       20

CONSTANTS USED: K49   K50

MTB > >REGRESS C2 ON 1 PRED C1 C9 C10

THE REGRESSION EQUATION IS
X1 = 1.04 + 0.529 T

                                      ST. DEV.    T-RATIO =
COLUMN        COEFFICIENT             OF COEF.    COEF/S.D.
                  1.0421               0.2787        3.74
T               0.52932               0.02326       22.75

S = 0.5999

R-SQUARED = 96.6 PERCENT
R-SQUARED = 96.5 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF          SS       MS=SS/DF
REGRESSION     1      186.32         186.32
RESIDUAL      18        6.48           0.36
TOTAL         19      192.80


DURBIN-WATSON STATISTIC = 2.27

MTB > >
```

TEH 0532578

DUP050033846

```
MTB > >REGRESS C2 ON 1 PRED C1 C11 C12

THE REGRESSION EQUATION IS
X1 = 1.04 + 0.529 T

                                  ST. DEV.     T-RATIO =
COLUMN        COEFFICIENT         OF COEF.     COEF/S.D.
                   1.0421          0.2787          3.74
T                 0.52932          0.02326        22.75

S = 0.5999

R-SQUARED = 96.6 PERCENT
R-SQUARED = 96.5 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF            SS        MS=SS/DF
REGRESSION     1        186.32          186.32
RESIDUAL      18          6.48            0.36
TOTAL         19        192.80


DURBIN-WATSON STATISTIC = 2.27

MTB > >REGRESS C3 ON 1 PRED C1 C11 C12

THE REGRESSION EQUATION IS
X2 = 2.93 + 0.302 T

                                  ST. DEV.     T-RATIO =
COLUMN        COEFFICIENT         OF COEF.     COEF/S.D.
                   2.9263          0.9229          3.17
T                 0.30226          0.07704         3.92

S = 1.987

R-SQUARED = 46.1 PERCENT
R-SQUARED = 43.1 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF            SS        MS=SS/DF
REGRESSION     1        60.753          60.753
RESIDUAL      18        71.047           3.947
TOTAL         19       131.800


DURBIN-WATSON STATISTIC = 2.88

MTB > >NAME C11 'ST X2',C12 'PRED X2'
MTB > >INFO

COLUMN      NAME        COUNT
C1          T              20
C2          X1             20
C3          X2             20
C4          E              20
C5          M              20
C6          Y RESID        20
C7          ST RESID       20
C8          PRED Y         20
C9          ST X1          20
```

1,04
4,06
~ 4

2,93
3,2
≃ 9

TEH 0532579

DUP050033847

```
C11         ST X2         20
C12         PRED X2       20

CONSTANTS USED: K49   K50

MTB > >LET C13=C2-C10
MTB > >LET C14=C3-C12
MTB > >NAME C13 'X1 RESID',C14 'X2 RESID'
MTB > >PRINT C13 C14
 ROW   X1 RESID  X2 RESID

   1   0.428571  -1.22857
   2  -0.100752   0.46917
   3  -0.630075   2.16692
   4   0.840602  -0.13534
   5   0.311278   1.56241
   6  -0.218045  -2.73985
   7  -0.747368   2.95789
   8   0.723308  -1.34436
   9   0.193985  -3.64662
  10  -0.335338   2.05113
  11  -0.864662  -0.25113
  12   0.606015   1.44662
  13   0.076692  -0.85564
  14  -0.452631  -3.15789
  15  -0.981955   2.53985
  16   0.488722  -1.76241
  17  -0.040601  -0.06466
  18  -0.569925   1.63308
  19   0.900752  -0.66917
  20   0.371429   1.02857

MTB > >REGRESS C5 ON 3 PRED C13 C14 C1

THE REGRESSION EQUATION IS
M = 20.8 + 4.06 X1 RESID + 3.20 X2 RESID + 6.88 T

                                     ST. DEV.     T-RATIO =
COLUMN        COEFFICIENT            OF COEF.     COEF/S.D.
                  20.755               2.098          9.89
X1 RESID           4.058               1.897          2.14
X2 RESID          3.1988              0.5729          5.58
T                 6.8846              0.1751         39.31

S = 4.516

R-SQUARED = 99.0 PERCENT
R-SQUARED = 98.8 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

 DUE TO       DF          SS       MS=SS/DF
REGRESSION     3       32156          10719
RESIDUAL      16         326             20
TOTAL         19       32482

CONTINUE? >
FURTHER ANALYSIS OF VARIANCE
SS EXPLAINED BY EACH VARIABLE WHEN ENTERED IN THE ORDER GIVEN
 DUE TO       DF          SS
REGRESSION     3       32156
X1 RESID       1           1
X2 RESID       1         636
T              1       31520
```

TEH 0532580

DUP050033848

DURBIN-WATSON STATISTIC = 1.34

TEH 0532581

8/26/83

NHANES II Study

Don Diggs

"want to publish something ASAP to get EPA/Annest/etc ~~attention~~"

Do whatever needs to be done ~~to~~ accomplish this

Jack Pierrard

we need a clear discussion of the split-plot ANCOV model in our report. why needed, assumptions, strengths, limitation etc

2 error terms
2 regressions
etc

Explanation for the layman

TEH 0532582

N33828.02

DUP050033850

$$y_{ijk} = \mu + R_j + T_i + \delta_{ij}$$

$$+ \alpha_k + \alpha T_{ik}$$

$$+ \beta_1 ( \quad )$$

$$+ \beta_2 ( \quad )$$

$$+ \epsilon_{ijk}$$

from JMP

we need to discuss this in our report -- how our model differs from CDC's

Ron

TEH 0532583

DUP050033851

COP
RDS 8-18-83
①

# Draft Outline for Pet Lab Report

Title: Analysis of Declining Blood Lead Levels During NHANES II and their Relationship to Gasoline Lead Exposure.

I. Introduction
   A. Background on Use of NHANES II study results
      - Proposed gasoline lead deregulations
      - Criteria document for lead
   B. Indictment of Gasoline Lead as Major Contributor to Decline of Blood-lead levels
   C. Purpose of report
      - Limitations on previous analyses relating blood lead to gasoline lead exposure
         - National gasoline lead consumption
         - Failure to properly account for between site variations
      - Recently released data on NCHS regarding site ID.

II. NHANES II Study
   A. Study design
      - Population of interest / demographics
      - Samples selected / use of lead weights
      - Itinerary / sites visited
   B. Purpose of study
      - Crosssectional snapshot
   C. Observed decline during four year study period
      - Coincident with decline in National gasoline lead consumption

TEH 0532584

N33828.03

DUP050033852

III. Gasoline Lead Exposure

A. Available gasoline lead data and gasoline sales data
- State
- National

B. Calculation of exposure indicies
- National
- Site specific (including lagged versions)

C. Suitability of National Gasoline Lead Use
- National time plots
- Site specific time plot
- Site itinerary time plot
- Histogram of correlation for site specific exposures with location of National and site itinerary noted
- Conclusion

D. Site itinerary gas density / blood lead & time correlations
- Actual and log units
- With and without 2-NYC sites
- Justify exclusion of NYC sites from further analysis

IV. Discussion of Analysis Approach

A. Recognition of Data Structure
- Nesting / Split Plot situation
- Define a split plot and whole plot factor
- Need to account for between and within site variations

B. Sequence of Analyses

1. Objective
- to construct empirical models (with & without gas exposure terms) to best predict an individual blood lead
- emphasis on estimating time trends unexplained by model terms

2. Need for a two stage approach
   - Two error term
   - Unbalanced data and can't be handled by SAS
3. Steps
   - General model
   - Within site adjustments
     - Ref. Daniel + Wood
     - Model / ref. Kempthorne + Federer
   - Between site analysis / model
   - Residual time analysis
   - Gas Pb Contribution analysis
     - Address why time term not put in model

II, Preparation of data base
A. Covariates to consider
   - Table headed by split plot / whole plot
   - Table of site # ID's along with names and counts of complete records + records with BPb + PSU/Strata
   - Values of covariates
   - Interpretation of site means
   - Use of complete records / counts of records excluded
   - Selection of covariates for analysis
   - Names of covariates used (use # ID for reference)
   - Lead wt. as a covariate

VI. Results of Analyses

A. Within site analyses

- Models 1, 1W, 2, 2W / terms with interactions
- Results compared - details of model 2W
- Diagnostics
- Plots of Adj. Site Means vs Raw Site Mean
- Adjusted values

  Table of raw versus adjusted for 1, 1W, 2, 2W

  identified by PSU / strata & site ID

B. Between Site Analyses

- Models considered / dependent variables used
- Comments on terms significant
- ~~Ea~~ $R_A^2$ results / table
- Show analysis for Model A & Model S
- Variance Components Test for $\sigma_B^2$ based on model A

C. Estimated Unexplained Time Trend and Gas Lead Contribution

- Note little confounding between gas Pb & PR+I terms
- Approx. Sig. of Time
- Table of unexplained time
- Table of gas. contribution
- Conclusions based on least $R_A^2$ from item B

D. Summary

- Best models 2I or 2R or 2S
- Bar chart of set 2 results
- Appropriateness for evaluating gas Pb only in presence of PR+I but note results when only gas Pb considered.
- Sign. trend remains after accounting for gas. Pb PR+I

VIII. Robust Analysis of Variance

A. Purpose
- downweight infl. obser.
- unbalanced data
- 2 variance components
- can do in one analyses (not two)
- can test for equality of ~~covariate~~ coefficients of same covariate appearing in within and between analyses

B. Model reparametrization

C. Time Trend of Site effects for model 2A & 2S

D. Variance component results

IX. Discussion and Comparison of Results of Other Studies

A. DuPont previous analyses in Docket

B. Pirkles analyses

C. Swartz "

D. Annest & Pirkle, NEJ of M

X. Summary
- Consistency of $\alpha$ in 1-2 range
- No evidence to suggest $\alpha$ is > 2
- Nat. gas Pb confounded with ...
- Structure of data requires within and between
- Study design & analysis assumes no variations in time due to real changes or induced changes by sampling itinerary in blood lead levels.

XI References

Appendices

TEH 0532588

DUP050033856

Gaur 75 — day of exam (Linear interpolation)

Glag 75 — 30 days before exam

Glag 275 — 45 "

Glag 375 — 60 "

9/9 Review ?

DWM
JML
WHF
SPB
JMM
JNS

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DUP050033857

## Within Site

| | | $Y$ | |
|---|---|---|---|
| Sets | 1 | BPb | — |
| | 1W | " | lead wt incl. |
| | 2 | Ln BPb | — |
| | 2W | " | lead wt incl. |

P + R + Lt. Wt.          n = 9241

→ Set of Adj. Site Mean Leads

→ Set of std errors

$$Y = \sum_{i=1} b_i X_i + P + R$$

## Between Site

n = 61

$Y = b_i$'s

$X = P + R + I + G$

no gas Pb for Honolulu

2 NY city sites unrealistic Pb values

TEH 0532590

DUP050033858

8-16-83
RDS

# Major Improvements in Our Analyses Over Previous Analyses

- Used best available index of gasoline lead exposure at each survey site

- Statistical analysis properly accounted for both within and between site variations. Previous analyses ignored between site variations

8-15-83

NHANES II Count Summaries - Inst. 31A

## Count Data

9936 records with venous BPb

9500 records complete with BPb, demographics and ~~gas~~. Gcur 75

436 records missing

| | |
|---|---|
| 320 | due to no income |
| 129 | due to ~~B~~ no gas for Honolulu |
| 449 | |
| -13 | no income from Honolulu |
| 436 | checks |

Site means for BPb, demographics, Gas Den 75, Gcur 75, Glag 75, Glag 275, Glag 375 + $\log_{10}$ of gas computed. ~~from for~~ Note Gas Den 75 present on 9206 records.

Within site regressions done on 9241 records (=9500 - 135 - 124) after excluding 2 NYC sites

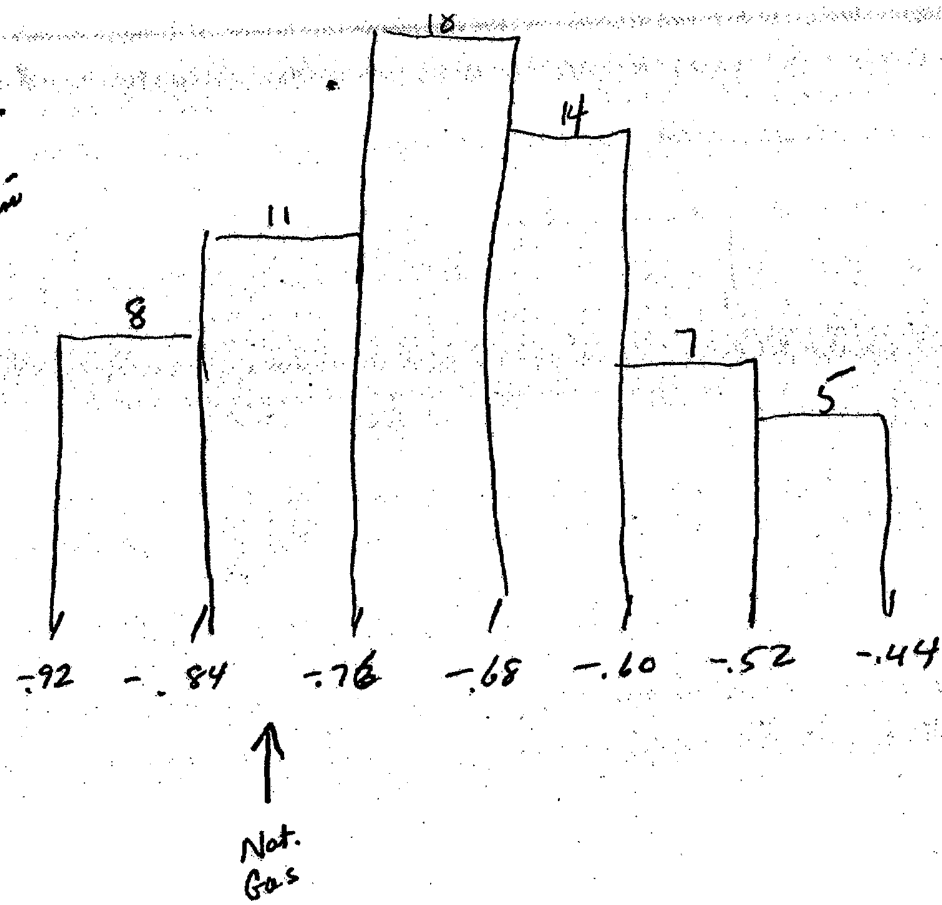
Between site regressions performed on site means based on 61 sites (no Honolulu & 2 NYC sites excl.)

TEH 0532592

DUP050033860

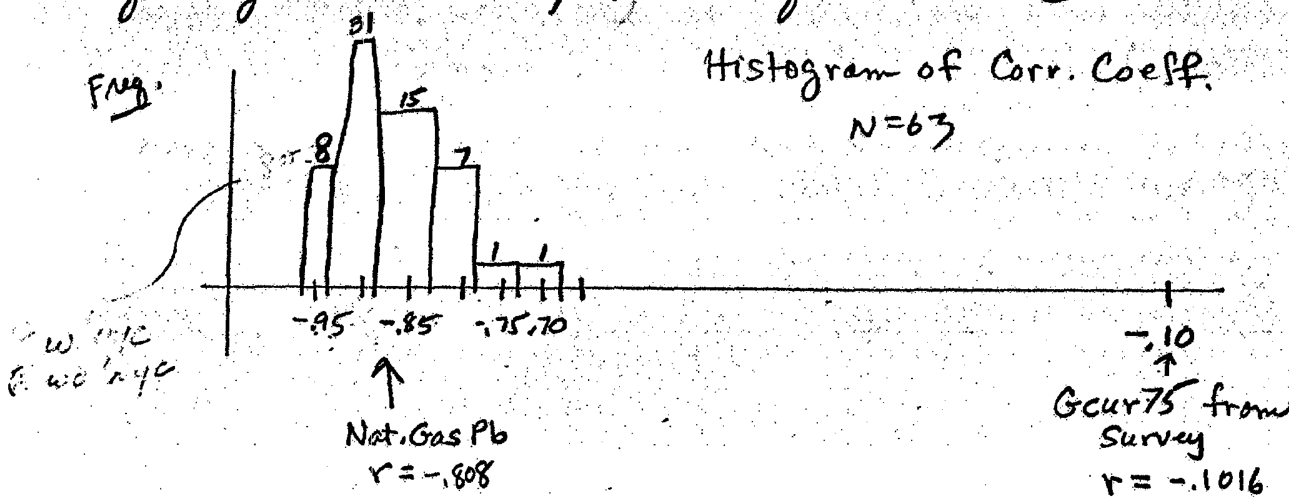
8-17-85

"17 month histo. of Correlation Coeff.



# Gasoline Lead Summaries

• 24 qtr. gasoline density trends for each site




Plot proves: • Time trend behavior in each site is consistent with national trend

• Gcur75 from survey itinerary is inconsistent with other trends and hence national Gas Pb is not an appropriate surrogate for specific site exposure

* Should develop above summaries using 17 qtrs during NHANES II

• Other Correlations (excl. Nyc sites)

- Gcur75 vs BPb $r = .444$ ($p = .0003$)
- Nat gas Pb vs BPb $r = .744$ ($p \le .0001$)
- Gcur75 vs Days Pb $r = -.1016$ ($p = .44$)
- Nat gas Pb vs " $r = -.808$ ($p \le .0001$)
- BPb vs " $r = -.7075$ ($p \le .0001$)

TEH 0532594

## Split Plot Factors [1]

### Personal [2] (P)

**Race**
- White
- * Black
- Other

**Sex**
- * Male
- Female

**Age**
- * Child (.5-5yrs)
- * Teen (6-17yrs)
- Adult (18-74yrs)

**Family Income**
- * Low (≤$10,000)
- High (>$10,000)

### Residence within Site (R)

**Urbanization**
- * Urban (    )
- Rural (    )

**SMSA**
- * Central City in SMSA
- Not Central City in SMSA
- Not SMSA

## Whole Plot Factors

### Itinerary (I)

**Season**
- * Winter
- * Spring
- * Summer
- Fall

**Region**
- * South
- * West
- * Northeast
- Midwest

### Gasoline Lead Exposure

- Current
- Lag 1 month
- Lag 1.5 months
- Lag 2 months

---

* Demographic Factors included in analyses of covariance

(1) Lead weight also investigated as a split plot factor

(2) For within and between site analyses all two way interactions among * P variables, except CH_TN, were included

8-18-83

## Approximate Tests for Between Site Variance Component > 0

RMS

| | Within Site $= \sigma_w^2$ | Between Site $= \sigma_B^2 + \frac{\sigma_w^2}{n}$ (based on unwtd regr.) |
|---|---|---|
| Model 1 | 27.3418 | 2.6526 |
| " 1W | 27.3098 | 2.7160 |
| " 2 | .106897 | .013224 |
| " 2W | .106645 | .013579 |

$$n = \frac{9241}{61}$$

### Approx Tests for $\sigma_B^2 = 0$

$$F = \frac{n \ RMS_B}{RMS_W} = 14.70 \quad \text{Model 1}$$

$$= 15.07 \quad \text{Model 1W}$$

$$= 18.79 \quad \text{" 2}$$

$$= 19.29 \quad \text{" 2W}$$

all highly significant

df

Num = 38
Den = 9164

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DUP050033864

$R^2_A$ Summaries from Between Site Analyses

8-19-83

| Model | WT = $1/s^2$ 1 | 1W | 2 | 2W | WT = N 1 | 1W | 2 | 2W | UNWTD 1 | 1W | 2 | 2W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | .53 | .52 | .55 | .54 | .65 | .64 | .68 | .67 | .52 | .50 | .55 | .53 |
| B | .59 | .58 | .59 | .58 | .69 | .69 | .71 | .70 | | | | |
| C | .59 | .58 | .59 | .58 | .69 | .69 | .71 | .70 | | | | |
| D | .59 | .58 | .59 | .58 | .69 | .68 | .71 | .70 | | | | |
| E | .59 | .58 | .59 | .57 | .69 | .69 | .70 | .70 | | | | |
| F | .57 | .55 | .59 | .58 | .68 | .67 | .71 | .70 | | | | |
| G | .57 | .56 | .59 | .58 | .68 | .67 | .71 | .70 | | | | |
| H | .56 | .55 | .58 | .57 | .68 | .67 | .71 | .70 | | | | |
| I | .60 | .59 | .62 | .61 | .71 | .70 | .73 | .73 | | | | |
| J | .59 | .58 | | | | | | | | | | |
| K | .59 | .57 | | | | | | | | | | |
| L | .58 | .57 | | | | | | | | | | |
| M | .59 | .57 | | | | | | | | | | |
| N | .58 | .57 | | | | | | | | | | |
| O | .58 | .57 | | | | | | | | | | |
| P | .56 | .55 | | | | | | | | | | |
| Q | .56 | .55 | | | | | | | | | | |
| R | .60 | .59 | .62 | .61 | .71 | .70 | .73 | .73 | | | | |
| S | .61 | .60 | .63 | .62 | .71 | .70 | .73 | .73 | | | | |
| T | .59 | .58 | | | | | | | | | | |
| U | .59 | .58 | | | | | | | | | | |
| V | .58 | .56 | | | | | | | | | | |
| W | .57 | .55 | | | | | | | | | | |
| X | .59 | .58 | | | | | | | | | | |
| Y | .60 | .59 | .61 | .60 | .71 | .70 | .73 | .72 | | | | |
| Z | .20 | .19 | | | | | | | | | | |
| AA | .21 | .20 | | | | | | | | | | |

Weighted Least Squares
Weight = Freq.

# Residual Time Trend Summaries

| | | ① Y = BPb | | ①W Y = BPb | | ② Y = Ln BPb | | Y = Ln BPb |
|---|---|---|---|---|---|---|---|---|
| | | No Lead Wt Cov | | Lead Wt Cov | | No Lead Wt Cov | | Lead |
| Model | Effects Removed | Res. Trend | Attrib to Gas | Res Trend | Attr. to Gas | Res Trend | Attrib to Gas | Res Trend |
| | None - Used Raw Data | 5.71 | | 5.47 | | 5.41 | | 4.66 |
| | None - Adj Site Means | | | | | | | |
| A | P, R & I | 1.79 | | 1.76 | | 1.69 | | 1.68 |
| B | A + Gas Den 75 | 1.44 | .35 | 1.43 | .33 | 1.40 | .29 | 1.40 |
| C | A + Gcur75 | 1.44 | .35 | 1.43 | .33 | 1.40 | .29 | 1.40 |
| D | A + Glag 75 | 1.45 | .34 | 1.45 | .31 | 1.43 | .26 | 1.43 |
| E | A + Gcur75 + Glag75 | 1.35 | .44 | 1.34 | .42 | 1.33 | .36 | 1.33 |
| F | A + $log_{10}$ Gas Den 75 | 1.54 | .25 | 1.54 | .22 | 1.46 | .23 | 1.46 |
| G | A + $log_{10}$ Gcur75 | 1.53 | .26 | 1.53 | .23 | 1.45 | .24 | 1.46 |
| H | A + $log_{10}$ Glag75 | 1.56 | .23 | 1.56 | .20 | 1.48 | .21 | 1.48 |
| I | A + $log_{10}$ Gcur75 + $log_{10}$ Glag75 | 1.11 | .68 | 1.11 | .55 | 1.04 | .65 | 1.04 |
| J | A + Glag275 | 1.46 | .33 | 1.46 | .30 | 1.43 | .26 | 1.43 |
| K | A + Glag375 | 1.47 | .32 | 1.46 | .30 | 1.43 | .26 | 1.43 |
| L | A + Gcur75 + Glag275 | 1.37 | .42 | 1.35 | .41 | 1.33 | .36 | 1.34 |
| M | A + Gcur75 + Glag375 | 1.37 | .42 | 1.36 | .40 | 1.34 | .35 | 1.36 |
| N | A + Glag75 + Glag275 | 1.40 | .39 | 1.39 | .37 | 1.36 | .33 | 1.36 |
| O | A + Glag75 + Glag375 | 1.39 | .40 | 1.38 | .38 | 1.36 | .33 | 1.36 |
| P | J w/logs | 1.57 | .22 | 1.57 | .19 | 1.49 | .20 | 1.49 |
| Q | K w/logs | 1.58 | .21 | 1.58 | .18 | 1.49 | .20 | 1.5 |
| R | L w/logs | 1.10 | .69 | 1.10 | .66 | 1.02 | .67 | 1.04 |
| S | M w/logs | 1.08 | .71 | 1.08 | .68 | 1.02 | .67 | 1.04 |
| T | N w/logs | 1.25 | .54 | 1.25 | .51 | 1.20 | .49 | 1.20 |
| U | O w/logs | 1.25 | .54 | 1.25 | .51 | 1.21 | .48 | 1.21 |
| V | E + Glag275 | 1.34 | .45 | 1.31 | .45 | 1.32 | .37 | 1.3 |
| W | V + Glag375 | 1.33 | .46 | 1.31 | .45 | 1.32 | .37 | 1.3 |
| X | V w/logs | 1.11 | .68 | 1.10 | .66 | 1.02 | .67 | 1.04 |
| Y | W w/logs | .96 | .83 | .96 | .80 | .92 | .77 | .93 |
| Z | Gcur75 | 5.09 | | 5.02 | | 4.52 | | 4.55 |
| AA | $log_{10}$ Gcur75 | 4.74 | | 4.76 | | 4.30 | | 4.34 |

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DUP05003866

# Residual Time Trend Summaries

Weighted Least-Squares
Weight = $1/s^2$

| | | Y = BPb | | | | Y = Ln BPb | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No Lead wt Cov | | Lead wt Cov | | No Lead wt Cov | | Lead wt Cov. | |
| Model | Effects Removed | Res. Trend | Attrib. to Gas | Res Trend | Attr. to Gas | Res Trend | Attrib to Gas | Res Trend | Attrib to Gas |
| | None - Used Raw Data | 5.80 | | 5.51 | | 5.42 | | 5.12 | |
| | None - Adj Site Means | | | | | | | | |
| A | P, R & I | 1.62 | | 1.62 | | 1.56 | | 1.56 | |
| B | A + Gas Den 75 | 1.27 | .35 | 1.27 | .35 | 1.28 | .28 | 1.28 | .28 |
| C | A + Gcur 75 | 1.27 | .35 | 1.27 | .35 | 1.28 | .28 | 1.28 | .28 |
| D | A + Glag 75 | 1.28 | .34 | 1.28 | .34 | 1.28 | .28 | 1.28 | .28 |
| E | A + Gcur 75 + Glag 75 | 1.21 | .41 | 1.22 | .40 | 1.22 | .34 | 1.22 | .34 |
| F | A + $\log_{10}$ Gas Den 75 | 1.48 | .14 | 1.48 | .14 | 1.42 | .14 | 1.42 | .14 |
| G | A + $\log_{10}$ Gcur 75 | 1.48 | .14 | 1.48 | .14 | 1.42 | .14 | 1.41 | .15 |
| H | A + $\log_{10}$ Glag 75 | 1.50 | .12 | 1.50 | .12 | 1.45 | .09 | 1.44 | .12 |
| I | A + $\log_{10}$ Gcur 75 + $\log_{10}$ Glag 75 | 1.10 | .52 | 1.10 | .52 | 1.04 | .52 | 1.04 | .52 |
| J | A + Glag 275 | 1.28 | .34 | 1.29 | .33 | 1.28 | .28 | 1.28 | .28 |
| K | A + Glag 375 | 1.29 | .33 | 1.29 | .33 | 1.29 | .27 | 1.28 | .28 |
| L | A + Gcur 75 + Glag 275 | 1.23 | .39 | 1.23 | .39 | 1.24 | .32 | 1.24 | .32 |
| M | A + Gcur 75 + Glag 375 | 1.23 | .39 | 1.23 | .39 | 1.24 | .32 | 1.24 | .32 |
| N | A + Glag 75 + Glag 275 | 1.25 | .37 | 1.26 | .36 | 1.26 | .30 | 1.25 | .31 |
| O | A + Glag 75 + Glag 375 | 1.25 | .37 | 1.25 | .37 | 1.25 | .31 | 1.25 | .31 |
| P | J w/logs | 1.51 | .11 | 1.50 | .12 | 1.45 | .09 | 1.44 | .12 |
| Q | K w/logs | 1.51 | .11 | 1.51 | .11 | 1.45 | .09 | 1.45 | .11 |
| R | L w/logs | 1.09 | .53 | 1.09 | .53 | 1.04 | .52 | 1.04 | .52 |
| S | M w/logs | 1.07 | .55 | 1.07 | .55 | 1.04 | .52 | 1.04 | .52 |
| T | N w/logs | 1.23 | .39 | 1.23 | .39 | 1.18 | .38 | 1.17 | .39 |
| U | O w/logs | 1.23 | .39 | 1.22 | .40 | 1.21 | .35 | 1.20 | .36 |
| V | E + Glag 275 | 1.19 | .43 | 1.19 | .43 | 1.20 | .36 | 1.20 | .36 |
| W | V + Glag 375 | 1.18 | .44 | 1.18 | .44 | 1.20 | .36 | 1.20 | .36 |
| X | V w/logs | 1.09 | .53 | 1.09 | .53 | 1.04 | .52 | 1.04 | .52 |
| Y | W w/logs | .96 | .66 | .95 | .67 | .94 | .62 | .93 | .63 |
| Z | Gcur 75 | 5.17 | | 5.17 | | 4.92 | | 4.90 | |
| AA | $\log_{10}$ Gcur 75 | 4.93 | | 4.93 | | 4.65 | | 4.66 | |

TEH 0532599

DUP050033867