

These data are crime-related and demographic statistics for 47 US states in 1960. The data were collected from the FBI's Uniform Crime Report and other government agencies to determine how the variable crime rate depends on the other variables measured in the study.

- 1.R: Crime rate: # of offenses reported to police per million population
- 2.Age: The number of males of age 14-24 per 1000 population
- 3.S: Indicator variable for Southern states (0 = No, 1 = Yes)
- 4.Ed: Mean # of years of schooling x 10 for persons of age 25 or older
- 5.Ex0: 1960 per capita expenditure on police by state and local government
- 6.Ex1: 1959 per capita expenditure on police by state and local government
- 7.LF: Labor force participation rate per 1000 civilian urban males age 14-24
- 8.M: The number of males per 1000 females
- 9.N: State population size in hundred thousands
- 10.NW: The number of non-whites per 1000 population
- 11.U1: Unemployment rate of urban males per 1000 of age 14-24
- 12.U2: Unemployment rate of urban males per 1000 of age 35-39
- 13.W: Median value of transferable goods and assets or family income in tens of \$
- 14.X: The number of families per 1000 earning below 1/2 the median income

```
>S-PLUS : Copyright (c) 1988, 1996 MathSoft, Inc.
```

```
S : Copyright AT&T.
```

```
Version 3.4 Release 1 for Silicon Graphics Iris, IRIX 5.3 : 1996
```

```
Working data will be in /home/emmanuel/.Data
```

```
> crime<-read.table("/home/emmanuel/Data/crime.dat",header = T)
```

```
> crime
```

	R	Age	S	Ed	Ex0	Ex1	LF	M	N	NW	U1	U2	W	X
1	79.1	151	1	91	58	56	510	950	33	301	108	41	394	261
2	163.5	143	0	113	103	95	583	1012	13	102	96	36	557	194
3	57.8	142	1	89	45	44	533	969	18	219	94	33	318	250
4	196.9	136	0	121	149	141	577	994	157	80	102	39	673	167
5	123.4	141	0	121	109	101	591	985	18	30	91	20	578	174
6	68.2	121	0	110	118	115	547	964	25	44	84	29	689	126
7	96.3	127	1	111	82	79	519	982	4	139	97	38	620	168

Forward Regression

```
> y<-crime$R
```

```
> X<-as.matrix(crime)[,-1]
```

```
> forward.reg<-stepwise(X,y,method="forward")
```

```
> forward.reg
```

```
$rss:
```

```
[1] 36276.26 28878.07 23007.57 20613.53 18603.65 17351.06 16942.45 16251.45
```

```
[9] 16079.98 15975.63 15913.43 15884.77 15878.70
```

```
$size:
```

```
[1] 1 2 3 4 5 6 7 8 9 10 11 12 13
```

```
$which:
```

```
      Age S Ed Ex0 Ex1 LF M N NW U1 U2 W X
1(+ 4)  F F F  T  F  F F F  F  F  F F F
2(+13)  F F F  T  F  F F F  F  F  F F T
3(+ 3)  F F T  T  F  F F F  F  F  F F T
4(+ 1)  T F T  T  F  F F F  F  F  F F T
5(+11)  T F T  T  F  F F F  F  F  T F T
6(+12)  T F T  T  F  F F F  F  F  T T T
7(+10)  T F T  T  F  F F F  F  T  T T T
8(+ 7)  T F T  T  F  F T F  F  T  T T T
9(+ 5)  T F T  T  T  F T F  F  T  T T T
10(+ 2) T T T  T  T  F T F  F  T  T T T
11(+ 8) T T T  T  T  F T T  F  T  T T T
12(+ 6) T T T  T  T  T T T  F  T  T T T
13(+ 9) T T T  T  T  T T T  T  T  T T T
```

```
$f.stat:
```

```
[1] 40.35658270 11.27222773 10.97166489 4.87786217 4.42951819 2.88762623
[7] 0.94057989 1.61572833 0.39456080 0.23515384 0.13679534 0.06133809
[13] 0.01261974
```

```
$method:
```

```
[1] "forward"
```

Backward Regression

```
> backward.reg<-stepwise(X,y,method="backward")
```

```
> backward.reg
```

```
$rss:
```

```
[1] 15884.77 15913.43 15975.63 16079.98 16251.45 16942.45 17351.06 18603.65
[9] 20613.53 23007.57 28878.07 36276.26 68809.28
```

```
$size:
```

```
[1] 12 11 10 9 8 7 6 5 4 3 2 1 0
```

```
$which:
```

```
      Age S Ed Ex0 Ex1 LF M N NW U1 U2 W X
12(- 9)  T T T  T  T  T T T  F  T  T T T
11(- 6)  T T T  T  T  F T T  F  T  T T T
10(- 8)  T T T  T  T  F T F  F  T  T T T
9(- 2)   T F T  T  T  F T F  F  T  T T T
```

```

8(- 5)  T F T  T  F  F T F  F  T  T T T
7(- 7)  T F T  T  F  F F F  F  T  T T T
6(-10)  T F T  T  F  F F F  F  F  T T T
5(-12)  T F T  T  F  F F F  F  F  T F T
4(-11)  T F T  T  F  F F F  F  F  F F T
3(- 1)  F F T  T  F  F F F  F  F  F F T
2(- 3)  F F F  T  F  F F F  F  F  F F T
1(-13)  F F F  T  F  F F F  F  F  F F F
0(- 4)  F F F  F  F  F F F  F  F  F F F

```

\$f.stat:

```

[1] 0.01261974 0.06133809 0.13679534 0.23515384 0.39456080 1.61572833
[7] 0.94057989 2.88762623 4.42951819 4.87786217 10.97166489 11.27222773
[13] 40.35658270

```

\$method:

```
[1] "backward"
```

### Stepwise Regression

```
> stepwise.reg<-stepwise(X,y,f.crit = 2)
```

```
Error: Object "method" not found
```

```
Dumped
```

```
> stepwise.reg<-stepwise(X,y,f.crit = 2)
```

```
> stepwise.reg
```

\$rss:

```
[1] 36276.26 28878.07 23007.57 20613.53 18603.65 17351.06
```

\$size:

```
[1] 1 2 3 4 5 6
```

\$which:

```

      Age S Ed Ex0 Ex1 LF M N NW U1 U2 W X
1(+ 4)  F F F  T  F  F F F  F  F  F F F
2(+13)  F F F  T  F  F F F  F  F  F F T
3(+ 3)  F F T  T  F  F F F  F  F  F F T
4(+ 1)  T F T  T  F  F F F  F  F  F F T
5(+11)  T F T  T  F  F F F  F  F  T F T
6(+12)  T F T  T  F  F F F  F  F  T T T

```

\$f.stat:

```
[1] 40.356583 11.272228 10.971665 4.877862 4.429518 2.887626
```

\$method:

```
[1] "efroymsen"
```

$C_p$  model selection

```
> crime.lm<-lm(R ~ ., data = crime)
> step(crime.lm)
Start: AIC= 29351.54
R ~ Age + S + Ed + Ex0 + Ex1 + LF + M + N + NW + U1 + U2 + W + X
```

Single term deletions

Model:

```
R ~ Age + S + Ed + Ex0 + Ex1 + LF + M + N + NW + U1 + U2 + W + X
```

scale: 481.1727

	Df	Sum of Sq	RSS	Cp
<none>			15878.70	29351.54
Age	1	2911.570	18790.27	31300.76
S	1	149.375	16028.08	28538.57
Ed	1	3700.487	19579.19	32089.68
Ex0	1	1109.830	16988.53	29499.02
Ex1	1	162.338	16041.04	28551.53
LF	1	34.391	15913.09	28423.58
M	1	296.505	16175.21	28685.70
N	1	48.873	15927.57	28438.07
NW	1	6.072	15884.77	28395.26
U1	1	911.498	16790.20	29300.69
U2	1	2108.841	17987.54	30498.03
W	1	810.573	16689.27	29199.77
X	1	5474.230	21352.93	33863.42

Step: AIC= 28395.26

```
R ~ Age + S + Ed + Ex0 + Ex1 + LF + M + N + U1 + U2 + W + X
```

Single term deletions

Model:

```
R ~ Age + S + Ed + Ex0 + Ex1 + LF + M + N + U1 + U2 + W + X
```

scale: 481.1727

	Df	Sum of Sq	RSS	Cp
<none>			15884.77	28395.26
Age	1	3365.775	19250.55	30798.69
S	1	158.041	16042.81	27590.96
Ed	1	3757.100	19641.87	31190.02
Ex0	1	1104.297	16989.07	28537.22
Ex1	1	156.268	16041.04	27589.19

LF	1	28.657	15913.43	27461.58
M	1	294.122	16178.89	27727.04
N	1	48.597	15933.37	27481.52
U1	1	913.149	16797.92	28346.07
U2	1	2107.119	17991.89	29540.04
W	1	820.199	16704.97	28253.12
X	1	5503.554	21388.33	32936.47

Step: AIC= 27461.58

R ~ Age + S + Ed + Ex0 + Ex1 + M + N + U1 + U2 + W + X

Single term deletions

Model:

R ~ Age + S + Ed + Ex0 + Ex1 + M + N + U1 + U2 + W + X

scale: 481.1727

	Df	Sum of Sq	RSS	Cp
<none>			15913.43	27461.58
Age	1	3407.856	19321.29	29907.09
S	1	129.394	16042.82	26628.63
Ed	1	3895.271	19808.70	30394.50
Ex0	1	1075.930	16989.36	27575.16
Ex1	1	134.773	16048.20	26634.00
M	1	276.777	16190.21	26776.01
N	1	62.197	15975.63	26561.43
U1	1	941.767	16855.20	27441.00
U2	1	2088.500	18001.93	28587.73
W	1	801.911	16715.34	27301.14
X	1	5621.265	21534.70	32120.50

Step: AIC= 26561.43

R ~ Age + S + Ed + Ex0 + Ex1 + M + U1 + U2 + W + X

Single term deletions

Model:

R ~ Age + S + Ed + Ex0 + Ex1 + M + U1 + U2 + W + X

scale: 481.1727

	Df	Sum of Sq	RSS	Cp
<none>			15975.63	26561.43
Age	1	3425.929	19401.56	29025.01
S	1	104.354	16079.98	25703.44
Ed	1	3887.628	19863.26	29486.71
Ex0	1	1021.257	16996.88	26620.34

Ex1	1	123.304	16098.93	25722.39
M	1	533.807	16509.43	26132.89
U1	1	997.747	16973.37	26596.83
U2	1	2082.317	18057.94	27681.40
W	1	748.730	16724.36	26347.81
X	1	5896.926	21872.55	31496.01

Step: AIC= 25703.44

R ~ Age + Ed + Ex0 + Ex1 + M + U1 + U2 + W + X

Single term deletions

Model:

R ~ Age + Ed + Ex0 + Ex1 + M + U1 + U2 + W + X

scale: 481.1727

	Df	Sum of Sq	RSS	Cp
<none>			16079.98	25703.44
Age	1	3354.463	19434.44	28095.55
Ed	1	4139.093	20219.07	28880.18
Ex0	1	1161.957	17241.94	25903.05
Ex1	1	171.474	16251.45	24912.56
M	1	563.438	16643.42	25304.53
U1	1	906.023	16986.00	25647.11
U2	1	1977.984	18057.96	26719.07
W	1	734.696	16814.68	25475.79
X	1	6094.784	22174.76	30835.87

Step: AIC= 24912.56

R ~ Age + Ed + Ex0 + M + U1 + U2 + W + X

Single term deletions

Model:

R ~ Age + Ed + Ex0 + M + U1 + U2 + W + X

scale: 481.1727

	Df	Sum of Sq	RSS	Cp
<none>			16251.45	24912.56
Age	1	3323.07	19574.52	27273.28
Ed	1	4005.09	20256.55	27955.31
Ex0	1	11818.77	28070.22	35768.99
M	1	691.00	16942.45	24641.22
U1	1	921.79	17173.25	24872.01
U2	1	2018.09	18269.54	25968.31
W	1	759.00	17010.46	24709.22

X 1 6402.74 22654.20 30352.96

Step: AIC= 24641.22

R ~ Age + Ed + Ex0 + U1 + U2 + W + X

Single term deletions

Model:

R ~ Age + Ed + Ex0 + U1 + U2 + W + X

scale: 481.1727

	Df	Sum of Sq	RSS	Cp
<none>			16942.45	24641.22
Age	1	4511.60	21454.06	28190.48
Ed	1	6430.56	23373.01	30109.43
Ex0	1	12019.62	28962.07	35698.49
U1	1	408.61	17351.06	24087.48
U2	1	1548.60	18491.05	25227.47
W	1	1016.86	17959.31	24695.73
X	1	8147.69	25090.14	31826.56

Step: AIC= 24087.48

R ~ Age + Ed + Ex0 + U2 + W + X

Single term deletions

Model:

R ~ Age + Ed + Ex0 + U2 + W + X

scale: 481.1727

	Df	Sum of Sq	RSS	Cp
<none>			17351.06	24087.48
Age	1	4461.00	21812.07	27586.14
Ed	1	6214.73	23565.79	29339.86
Ex0	1	15596.51	32947.58	38721.65
U2	1	1628.68	18979.75	24753.82
W	1	1252.58	18603.65	24377.72
X	1	8932.28	26283.34	32057.41

Call:

lm(formula = R ~ Age + Ed + Ex0 + U2 + W + X, data = crime)

Coefficients:

(Intercept)	Age	Ed	Ex0	U2	W	X
-618.5028	1.12518	1.817863	1.050687	0.8281694	0.1595649	0.8235714

Degrees of freedom: 47 total; 40 residual

Residual standard error (on weighted scale): 20.8273