APPENDIX A : Typical SAS Code Files, Log Files, and Output of the Selected Models for the Prediction of Decrease in Structural Number

Statistical Analysis System (SAS) Codes

```
Title1 ' FDBIT PAVEMENTS' ;
Title2 ' Prediction of del(SN) from age, thickness and cumulative ESAL' ;
options ls= 80 ps= 60;
data;
input dsn age th cumESAL;
cards;
0.098 4 16. 5 599087
0.0924 6 13. 9 745738
0.0582 3 13. 8 129687
0.0876 5 9. 8 301154
0.023 1 11. 8 53125
0.1116 6 10. 3 925514
0.1292 6 12. 4 810048
0.1225 7 13. 5 407297

0.204 13 7. 8 965029
0.08 5 19 298817
0.09 6 14. 4 385079
0.13 8 12. 6 889037
0.08 5 14. 7 461194

0.09 6 11. 4 238113
0.099 6 17. 5 394265
0.236 15 14 1782951

0.18 6 15. 6 1326061
0.168 6 18. 8 1722453
0.171 6 17 1636727
0.151 5 14. 1 531323
0.171 5 12. 2 675370
0.14 5 12. 2 675370
0.184 7 11. 9 1126211
0.16 6 15. 6 2135526
0.281 9 19. 4 623234
0.219 10 19. 8 3723550

0.055 2 14. 6 995321
0.19 7 14. 9 2087479
0.131 5 17. 4 2388042
```

```
0.059 2 17.6 1119591
0.204 7 10.5 176723

0.49 17 18.7 4041889
0.09 3 10 227849
0.08 3 12.3 267089
0.1 3 12.3 267089
0.09 3 12.3 365729
0.27 9 19.1 2013217
0.39 16 16.2 3295945
0.44 16 16.7 1363570
proc anova;
class dsn;
model dsn= age th;
proc reg;
model dsn =  age th cumESAL;
model dsn =  age th cumESAL/noint;
model dsn =  age cumESAL;
model dsn =  age cumESAL/noint;
model dsn =  age th;
model dsn =  age th/noint;
proc stepwise;
model dsn =  age th cumESAL/F B stepwise;
proc rsquare;
model dsn =  age th cumESAL/adjrsq cp rmse;
proc corr;
run;
```

The SAS System : Log File

```
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NOTE: SAS (r) Proprietary Software Release 6.12  TS020
      Licensed to KANSAS STATE UNIVERSITY, Site 0003010005.

This message is contained in the SAS news file, and is presented upon
initialization.  Edit the files "news" in the "misc/base" directory to
display site-specific news and information in the program log.
The command line option "-nonews" will prevent this display.

NOTE: AUTOEXEC processing beginning; file is /usr/local/lic/sas612/autoexec.sas.

NOTE: SAS initialization used:
      real time           0.760 seconds
      cpu time            0.533 seconds

NOTE: AUTOEXEC processing completed.
1
2          Title1 'FDBIT PAVEMENTS';
3          Title2 'Prediction of del(SN) from age, thickness and cumulative ESAL';
4          options ls= 80 ps= 60;
5          data;
6          input dsn age th cumESAL;
7          cards;

NOTE: SAS went to a new line when INPUT statement reached past the end of a  line.
NOTE: DATA statement used:
      real time           0.230 seconds
      cpu time            0.113 seconds

52         proc anova;
53         class dsn;
54         model dsn= age th;
```

```
NOTE: PROCEDURE ANOVA used:
      real time           0.020 seconds
      cpu time            0.019 seconds

55          proc reg;
56          model dsn =  age th cumESAL;
57          model dsn =  age th cumESAL/noint;
58          model dsn =  age cumESAL;
59          model dsn =  age cumESAL/noint;
60          model dsn =  age th;
61          model dsn =  age th/noint;

NOTE: The PROCEDURE REG printed pages 1-6.
NOTE: PROCEDURE REG used:
      real time           0.410 seconds
      cpu time            0.141 seconds

62          proc stepwise;
63          model dsn =  age th cumESAL/F B stepwise;

NOTE: The PROCEDURE STEPWISE printed pages 7-10.
NOTE: PROCEDURE STEPWISE used:
      real time           0.310 seconds
      cpu time            0.082 seconds

64          proc rsquare;
65          model dsn =  age th cumESAL/adjrsq cp rmse;

NOTE: The PROCEDURE RSQUARE printed page 11.
NOTE: PROCEDURE RSQUARE used:
      real time           0.290 seconds
      cpu time            0.059 seconds

66          proc corr;
67          run;

NOTE: The PROCEDURE CORR printed page 12.
NOTE: PROCEDURE CORR used:
      real time           0.010 seconds
      cpu time            0.018 seconds

NOTE: The SAS System used:
```

real time 2.110 seconds
cpu time 1.029 seconds
NOTE: SAS Institute Inc., SAS Campus Drive, Cary, NC USA 27513-2414

Output : FDBIT PAVEMENTS

Model: MODEL6 Selected Model

NOTE: No intercept in model.
Dependent Variable: DSN

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	*F Value*	*Prob> F*
Model	2	1.29274	0.64637	*320.035*	*0.0001*
Error	37	0.07473	0.00202		
U Total	39	1.36747			

Root MSE	0.04494	*R-square*	*0.8127*
Dep Mean	0.15758	Adj R-sq	0.8095
C.V.	28.51995		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter= 0	Prob > | T|
AGE	1	**0.021872**	0.00189214	11.560	*0.0001*
TH	1	**0.001025**	0.00099054	1.034	*0.0176*

Forward Selection Procedure for Dependent Variable DSN

Step 1 Variable AGE Entered R-square = 0.80739593 C(p) = 7.25384676

	DF	Sum of Squares	Mean Square	F	Prob> F
Regression	1	0.32221333	0.32221333	155.10	0.0001
Error	37	0.07686390	0.00207740		
Total	38	0.39907723			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob> F
INTERCEP	0.00160524	0.01449521	0.00002548	0.01	0.9124
AGE	0.02339575	0.00187856	0.32221333	155.10	0.0001

Bounds on condition number: 1, 1

Step 2 Variable TH Entered R-square = 0.83423771 C(p) = 3.36524639

	DF	Sum of Squares	Mean Square	F	Prob> F
Regression	2	0.33292527	0.16646264	90.59	0.0001
Error	36	0.06615196	0.00183755		
Total	38	0.39907723			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob> F
INTERCEP	-0.07279728	0.03369669	0.00857622	4.67	0.0375
AGE	0.02235521	0.00181859	0.27766797	151.11	0.0001
TH	0.00563853	0.00233535	0.01071194	5.83	0.0210

Bounds on condition number: 1.059501, 4.238002

All variables have been entered into the model.

Summary of Forward Selection Procedure for Dependent Variable DSN

Step	Variable Entered	Number In	Partial R**2	Model R**2	C(p)	F	Prob> F
1	AGE	1	0.8074	0.8074	7.2538	155.1039	0.0001
2	TH	2	0.0268	0.8342	3.3652	5.8295	0.0210
3	CUMESAL	3	0.0062	0.8405	4.0000	1.3652	0.2505

Backward Elimination Procedure for Dependent Variable DSN

Step 0 All Variables Entered R-square = 0.84046086 C(p) = 4.00000000

	DF	Sum of Squares	Mean Square	F	Prob> F
Regression	3	0.33540879	0.11180293	61.46	0.0001
Error	35	0.06366844	0.00181910		
Total	38	0.39907723			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob> F
INTERCEP	-0.05017719	0.03871490	0.00305571	1.68	0.2034
AGE	0.02062992	0.00233545	0.14194129	78.03	0.0001
TH	0.00392011	0.00274992	0.00369669	2.03	0.1629
CUMESAL	0.00000001	0.00000001	0.00248352	1.37	0.2505

Bounds on condition number: 2.389366, 16.9151

Step 1 Variable CUMESAL Removed R-square = 0.83423771 C(p) = 3.36524639

	DF	Sum of Squares	Mean Square	F	Prob> F
Regression	2	0.33292527	0.16646264	90.59	0.0001
Error	36	0.06615196	0.00183755		
Total	38	0.39907723			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob> F
INTERCEP	-0.07279728	0.03369669	0.00857622	4.67	0.0375
AGE	0.02235521	0.00181859	0.27766797	151.11	0.0001
TH	0.00563853	0.00233535	0.01071194	5.83	0.0210

Bounds on condition number: 1.059501, 4.238002

All variables left in the model are significant at the 0.1000 level.

Summary of Backward Elimination Procedure for Dependent Variable DSN

Step	Variable Removed	Number In	Partial R**2	Model R**2	C(p)	F	Prob> F
1	CUMESAL	2	0.0062	0.8342	3.3652	1.3652	0.2

Stepwise Procedure for Dependent Variable DSN

Step 1 Variable AGE Entered R-square = 0.80739593 C(p) = 7.25384676

	DF	Sum of Squares	Mean Square	F	Prob> F
Regression	1	0.32221333	0.32221333	155.10	0.0001
Error	37	0.07686390	0.00207740		
Total	38	0.39907723			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob> F
INTERCEP	0.00160524	0.01449521	0.00002548	0.01	0.9124
AGE	0.02339575	0.00187856	0.32221333	155.10	0.0001

Bounds on condition number: 1, 1

Step 2 Variable TH Entered R-square = 0.83423771 C(p) = 3.36524639

	DF	Sum of Squares	Mean Square	F	Prob> F

Regression	2	0.33292527	0.16646264	90.59	0.0001
Error	36	0.06615196	0.00183755		
Total	38	0.39907723			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob> F
INTERCEP	-0.07279728	0.03369669	0.00857622	4.67	0.0375
AGE	0.02235521	0.00181859	0.27766797	151.11	0.0001
TH	0.00563853	0.00233535	0.01071194	5.83	0.0210

Bounds on condition number: 1.059501, 4.238002

All variables left in the model are significant at the 0.1500 level.
No other variable met the 0.1500 significance level for entry into the model.

Summary of Stepwise Procedure for Dependent Variable DSN

Step	Variable Entered/ Removed		Partial R**2	Model R**2	C(p)	F	Prob> F
1	AGE	1	0.8074	0.8074	7.2538	155.1039	0.0001
2	TH	2	0.0268	0.8342	3.3652	5.8295	0.001

Number in Model	R-square	Adjusted R-square	C(p)	Root MSE	Variables in Model
1	0.80739593	0.80219041	7.25385	0.04557853	AGE
1	0.48461521	0.47068589	78.06610	0.07455786	CUMESAL
1	0.13846268	0.11517788	154.00569	0.09639725	TH
2	0.83423771	0.82502869	3.36525	0.04286670	AGE TH
2	0.83119775	0.82181985	4.03216	0.04325799	AGE CUMESAL
2	0.48478711	0.45616418	80.02838	0.07557368	TH CUMESAL
3	0.84046086	0.82678607	4.00000	0.04265089	AGE TH CUMESAL

Correlation Analysis

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
DSN	39	0.15758	0.10248	6.14550	0.02300	0.49000
AGE	39	6.66667	3.93589	260.00000	1.00000	17.00000
TH	39	14.42564	3.06497	562.60000	7.80000	19.80000
CUMESAL	39	1081320	988399	42171493	53125	4041889

Pearson Correlation Coefficients / Prob > | R| under Ho: Rho= 0

	DSN	AGE	TH	CUMESAL
DSN	1.00000 0.0	0.89855 0.0001	0.37211 0.0197	0.69614 0.0001
AGE	0.89855 0.0001	1.00000 0.0	0.23698 0.1463	0.64328 0.0001
TH	0.37211 0.0197	0.23698 0.1463	1.00000 0.0	0.55025 0.0003
CUMESAL	0.69614 0.0001	0.64328 0.0001	0.55025 0.0003	1.00000 0.0