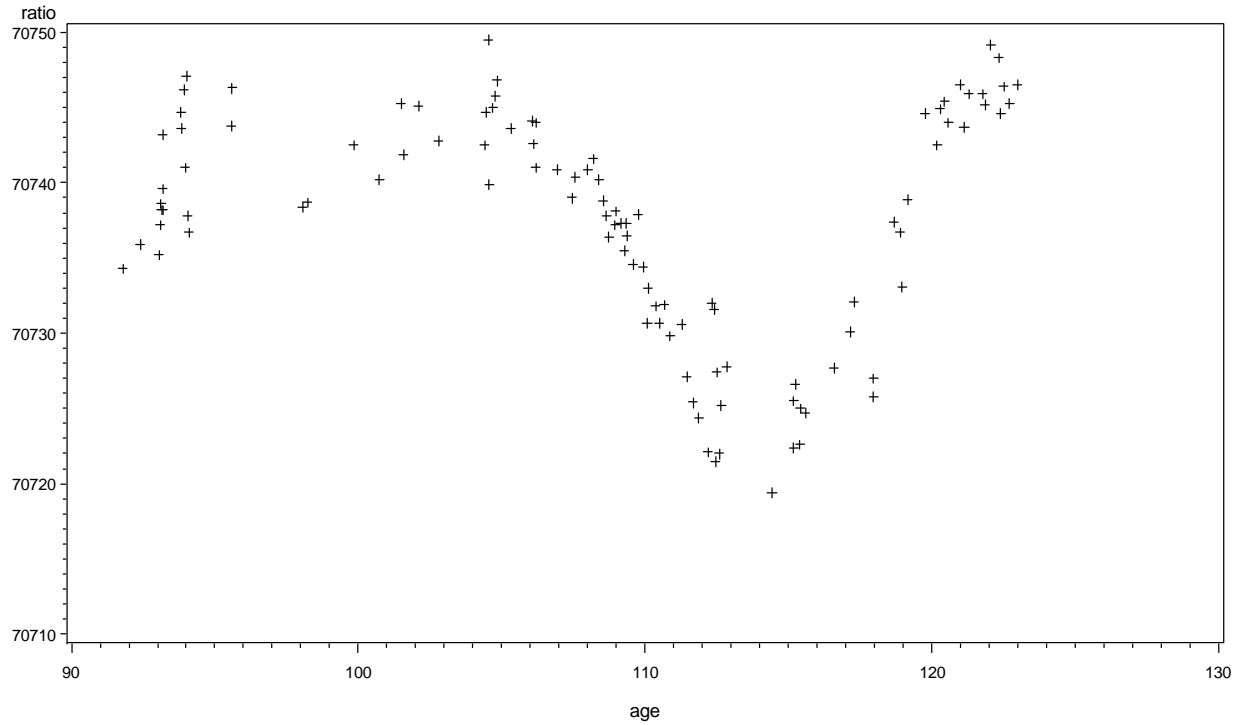


Ratio vs age, Fossil Data



Knot locations - Number and location chosen by Ngo and Wand's macro 1

Obs	knots
1	93.130
2	93.823
3	94.047
4	98.240
5	102.100
6	104.570
7	106.063
8	107.460
9	108.550
10	109.170
11	109.760
12	110.520
13	111.690
14	112.460
15	114.441
16	115.410
17	117.971
18	119.163
19	120.587
20	121.873
21	122.712

The Mixed Procedure

Model Information

Data Set	WORK.FOSSIL2
Dependent Variable	ratio
Covariance Structure	Diagonal
Estimation Method	REML
Residual Variance Method	Profile
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Residual

Dimensions

Covariance Parameters	1
Columns in X	23
Columns in Z	0
Subjects	1
Max Obs Per Subject	106

Number of Observations

Number of Observations Read	106
Number of Observations Used	106
Number of Observations Not Used	0

Covariance Parameter Estimates

Cov Parm	Estimate
Residual	6.1157

Fit Statistics

-2 Res Log Likelihood	416.5
AIC (smaller is better)	418.5
AICC (smaller is better)	418.5
BIC (smaller is better)	420.9

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
age	1	83	2.81	0.0972
Z1	1	83	3.41	0.0685
Z2	1	83	4.30	0.0413
Z3	1	83	2.21	0.1407

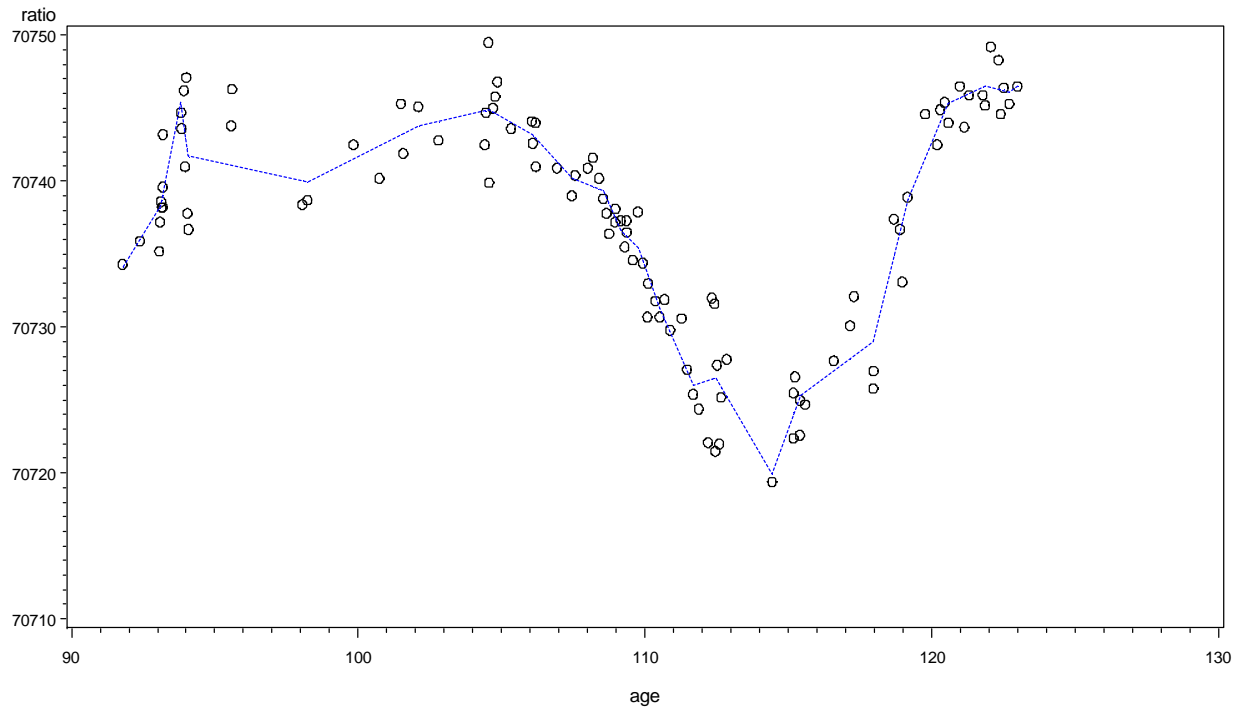
The Mixed Procedure

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
Z4	1	83	1.86	0.1767
Z5	1	83	0.20	0.6522
Z6	1	83	1.00	0.3192
Z7	1	83	0.18	0.6717
Z8	1	83	0.15	0.7033
Z9	1	83	0.50	0.4837
Z10	1	83	0.12	0.7354
Z11	1	83	0.27	0.6071
Z12	1	83	0.04	0.8443
Z13	1	83	1.63	0.2051
Z14	1	83	1.62	0.2060
Z15	1	83	4.74	0.0324
Z16	1	83	1.59	0.2103
Z17	1	83	8.23	0.0052
Z18	1	83	1.45	0.2325
Z19	1	83	1.78	0.1862
Z20	1	83	0.11	0.7376
Z21	1	83	0.02	0.8835

Plot of 21-knot linear spline model (Model 1) fit with fixed effects

Fossil Data



The Mixed Procedure

Model Information

Data Set	WORK.FOSSIL2
Dependent Variable	ratio
Covariance Structure	Banded Toeplitz
Estimation Method	REML
Residual Variance Method	Profile
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Containment

Dimensions

Covariance Parameters	2
Columns in X	2
Columns in Z	21
Subjects	1
Max Obs Per Subject	106

Number of Observations

Number of Observations Read	106
Number of Observations Used	106
Number of Observations Not Used	0

Convergence criteria met.

Covariance Parameter
Estimates

Cov Parm	Estimate
Variance	4.7345
Residual	6.1660

Fit Statistics

-2 Res Log Likelihood	533.4
AIC (smaller is better)	537.4
AICC (smaller is better)	537.5
BIC (smaller is better)	533.4

The Mixed Procedure

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
1	195.40	<.0001

Solution for Fixed Effects

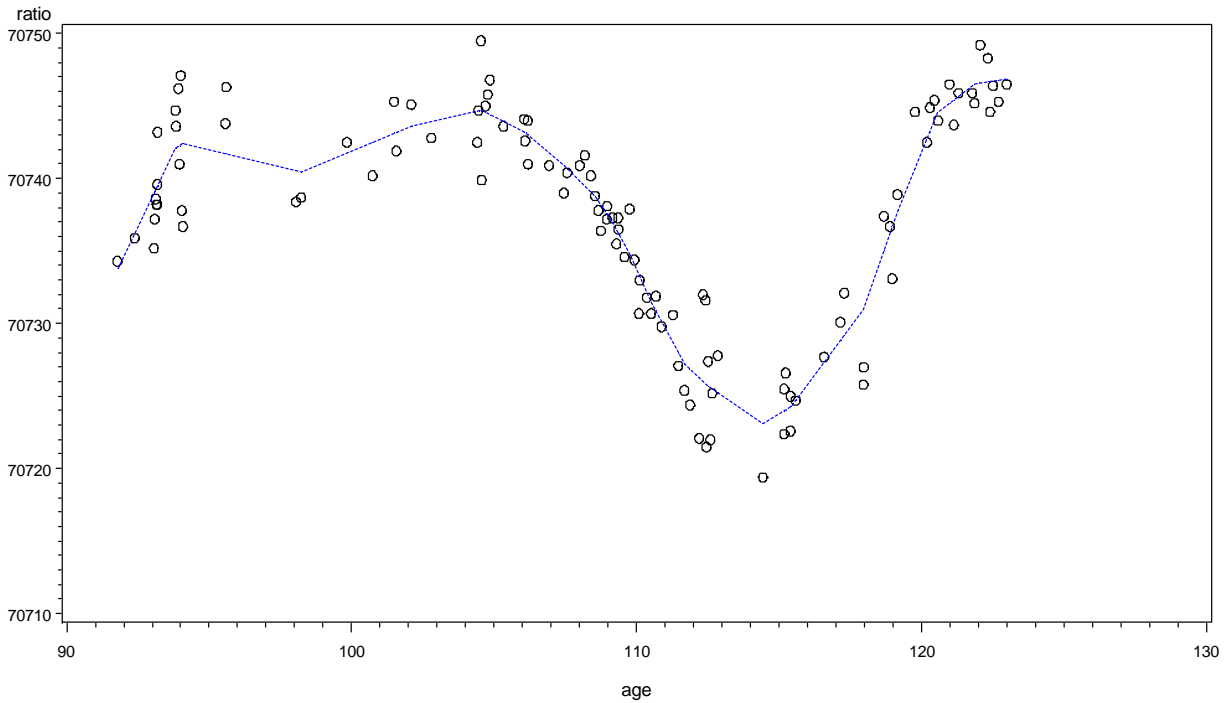
Effect	Estimate	Standard Error	DF	t Value	Pr > t
Intercept	70366	127.15	83	553.40	<.0001
age	4.0022	1.3666	83	2.93	0.0044

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
age	1	83	8.58	0.0044

Plot of 21-knot linear spline model (Model 2) fit with mixed effects

Fossil Data



The Mixed Procedure

Model Information

Data Set	WORK.FOSSIL2
Dependent Variable	ratio
Covariance Structure	Banded Toeplitz
Estimation Method	REML
Residual Variance Method	Profile
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Containment

Dimensions

Covariance Parameters	2
Columns in X	3
Columns in Z	21
Subjects	1
Max Obs Per Subject	106

Number of Observations

Number of Observations Read	106
Number of Observations Used	106
Number of Observations Not Used	0

Convergence criteria met.

Covariance Parameter
Estimates

Cov Parm	Estimate
Variance	0.2722
Residual	6.6703

Fit Statistics

-2 Res Log Likelihood	541.0
AIC (smaller is better)	545.0
AICC (smaller is better)	545.1
BIC (smaller is better)	541.0

The Mixed Procedure

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
1	182.42	<.0001

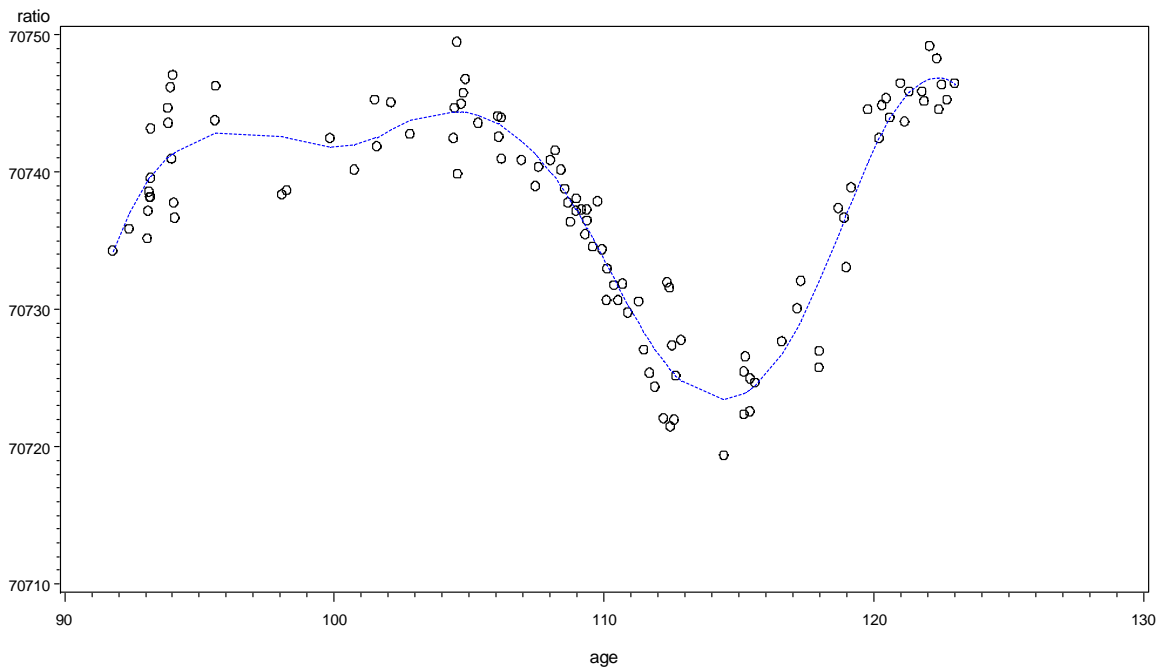
Solution for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > t
Intercept	63077	5616.31	82	11.23	<.0001
age	161.76	120.39	82	1.34	0.1828
age2	-0.8535	0.6452	82	-1.32	0.1895

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
age	1	82	1.81	0.1828
age2	1	82	1.75	0.1895

Plot of 21-knot quadratic spline model (Model 3) fit with mixed effects
Fossil Data



Model 4: Uses the radial smoother in PROC GLIMMIX to smooth the fossil data 8
This PROC has an automatic knot selection routine built in

The GLIMMIX Procedure

Model Information

Data Set	WORK.FOSSIL
Response Variable	ratio
Response Distribution	Gaussian
Link Function	Identity
Variance Function	Default
Variance Matrix	Not blocked
Estimation Technique	Restricted Maximum Likelihood
Degrees of Freedom Method	Containment

Radial Smoother
Knots for
RSmooth(age)

Knot Number	age
1	91.7853
2	93.0982
3	93.1875
4	93.8507
5	94.0120
6	95.6029
7	99.8400
8	101.57
9	104.42
10	104.70
11	105.34
12	106.19
13	107.46
14	108.40
15	108.75
16	109.17
17	109.37
18	110.09
19	110.52
20	111.48
21	112.21
22	112.52
23	112.86
24	115.19
25	115.41
26	117.30
27	118.69
28	119.16
29	120.31
30	121.14
31	121.87
32	122.41

Model 4: Uses the radial smoother in PROC GLIMMIX to smooth the fossil data 9
 This PROC has an automatic knot selection routine built in

The GLIMMIX Procedure

Radial Smoother
 Knots for
 RSmooth(age)

Knot Number	age
33	123.00

Number of Observations Read	106
Number of Observations Used	106

Dimensions

G-side Cov. Parameters	1
R-side Cov. Parameters	1
Columns in X	2
Columns in Z	33
Subjects (Blocks in V)	1
Max Obs per Subject	106

Optimization Information

Optimization Technique	Dual Quasi-Newton
Parameters in Optimization	1
Lower Boundaries	1
Upper Boundaries	0
Fixed Effects	Profiled
Residual Variance	Profiled
Starting From	Data

Iteration History

Iteration	Restarts	Evaluations	Objective Function	Change	Max Gradient
0	0	4	649.54657799	.	262048.1
1	0	19	565.78038826	83.76618973	8000.061
2	0	6	551.63032571	14.15006254	2709.309
3	0	6	541.88590207	9.74442364	689.7653
4	0	6	537.69710258	4.18879950	113.5902
5	0	4	537.17579819	0.52130439	28.4644
6	0	3	537.12427209	0.05152610	10.5048
7	0	3	537.11152897	0.01274312	2.713148
8	0	3	537.11072108	0.00080789	0.297534
9	0	3	537.1107116	0.00000947	0.007404

Model 4: Uses the radial smoother in PROC GLIMMIX to smooth the fossil dat 10
 This PROC has an automatic knot selection routine built in

The GLIMMIX Procedure

Iteration History

Iteration	Restarts	Evaluations	Objective Function	Change	Max Gradient
10	0	3	537.1107116	0.00000001	2.761E-6

Convergence criterion (GCONV=1E-8) satisfied.

Fit Statistics

-2 Res Log Likelihood	537.11
AIC (smaller is better)	541.11
AICC (smaller is better)	541.23
BIC (smaller is better)	537.11
CAIC (smaller is better)	539.11
HQIC (smaller is better)	537.11
Generalized Chi-Square	658.93
Gener. Chi-Square / DF	6.34
Radial Smoother df(res)	93.63

Covariance Parameter Estimates

Cov Parm	Estimate	Standard Error
Var[RSmooth(age)]	0.2464	0.1231
Residual	6.3359	0.9410

Solutions for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > t
Intercept	70815	334.82	71	211.50	<.0001
age	-0.8102	3.0968	93.63	-0.26	0.7942

Type III Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
age	1	93.63	0.07	0.7942

Plot of radial smoother spline model (Model 4) fit with mixed effects

Fossil Data

