

Criterion	Without		With		Reduced Model
	Covariates		Covariates		
-2 LOG L	128.121		125.908		
Test	Chi-Square		DF	Pr > ChiSq	
Likelihood Ratio	2.2133		3	0.5293	
Parameter	Standard				
Variable	DF	Estimate	Error	Chi-Square	Pr > ChiSq
age	1	0.46568	0.57757	0.6501	0.4201
weight	1	-0.00420	0.00289	2.1165	0.1457
length	1	0.01284	0.04081	0.0989	0.7531

Criterion	Without		With		Full Model
	Covariates		Covariates		
-2 LOG L	128.121		123.083		
Test	Chi-Square		DF	Pr > ChiSq	
Likelihood Ratio	5.0388		6	0.5388	
Parameter	Standard				
Variable	DF	Estimate	Error	Chi-Square	Pr > ChiSq
age	1	4.36658	3.47574	1.5783	0.2090
weight	1	-0.0004477	0.01115	0.0016	0.9680
length	1	0.01062	0.18366	0.0033	0.9539
agelt	1	-1.27256	1.10274	1.3317	0.2485
weightlt	1	-0.00121	0.00364	0.1116	0.7383
lengthlt	1	0.0003151	0.05768	0.0000	0.9956

1) The black duck data is from Collett (2003, p. 366). Y is survival time in days, and the reduced model is the PH model with predictors *age* (0 hatch year bird, 1 bird aged ≥ 1 year), *weight* of duck in grams, and *length* of wing in mm. The GCR model is the full model and adds $agelt = age \cdot \log(\text{time})$, $weightlt = weight \cdot \log(\text{time})$ and $lengthlt = length \cdot \log(\text{time})$ interactions to test whether the PH assumption is reasonable.

a) Test whether the reduced model is good.

H_0 reduced model is good H_A use the full model

$$\chi^2(RIF) = \chi^2(NIF) - \chi^2(NIR) = 5.0388 - 2.2133 = 2.8255$$

$$p\text{-val} = P(\chi^2_3 > 2.8255) \approx 0.23$$

24	125
3	4.11

Fail to reject H_0

the reduced model is good

b) Is the PH assumption reasonable?

Yes

Criterion	Without Covariates	With Covariates	Full Model		
-2 LOG L	204.801	177.740			
Test	Chi-Square	DF	Pr >	ChiSq	
Likelihood Ratio	27.0615	6	0.0001		
Parameter	Standard				
Variable	DF	Estimate	Error	Chi-Square	Pr > ChiSq
perf	1	-0.11415	0.03909	8.5259	0.0035
type	1	-0.49892	1.09251	0.2086	0.6479
trt	1	-0.34667	0.97596	0.1262	0.7224
perflt	1	0.01633	0.01028	2.5208	0.1124
typelt	1	0.12005	0.28977	0.1716	0.6787
trtlt	1	0.17496	0.24548	0.5080	0.4760

2) The advanced lung cancer data is from Leemis (1995, p. 249). The GCR model has predictors *perf*, *type*, *trt*, *perflt* = *perf**log(time), *typelt* = *type**log(time) and *trtlt* = *trt**log(time). (The interactions are used to test whether the PH assumption is reasonable.)

a) Test whether $\beta = 0$. $H_0 \beta = 0$ $H_A \beta \neq 0$

$$\chi^2(NIF) = 27.0615$$

$$pval = 0.0001$$

reject H_0 there is a GCR survival relationship

between Y and the predictors (*perf*, ..., *trtlt*)

b) Test whether $\beta_1 = 0$. $H_0 \beta_1 = 0$ $H_A \beta_1 \neq 0$

$$\chi^2_{01} = 8.5259$$

$$pval = 0.0035$$

reject H_0 , *perf* is needed in the GCR

survival model given the other predictors (*type*, ..., *trtlt*) are in the model

c) Test whether $\beta_3 = 0$.

$$H_0 \beta_3 = 0 \quad H_A \beta_3 \neq 0$$

$$\chi^2_{03} = 0.1262$$

$$pval = 0.7224$$

fail to reject H_0 , *trt* is not needed in the GCR

survival model given the other predictors are in the model