

Estimating mortality probabilities of Australian wild rabbits challenged with RHDV using pre-challenged antibody cut-off values

Hwan-Jin Yoon, Steve McPhee, Kym Butler

Primary Industries Research Victoria
Department of Primary Industries

Background (RHD)

- Formerly known as Rabbit Calicivirus Disease
- 1991 Australian quarantine trials commence to evaluate the virus as a biological control agent
- March 95 field trials to evaluate RHD in a natural environment commenced on Wardang Island
- October 95 the virus escaped from the Island and spread across the continent
- 1996 a non-lethal form of calicivirus was identified which existed in Australia before RHD occurred in 1995

Outcomes

- Major declines in rabbit populations have occurred compared populations recorded prior to the occurrence of RHD in 1995-96.
- These declines have been maintained over the past 5-6 years and are due to the combined effects of improved conventional rabbit control programs, RHD and Myxomatosis.
- Levels of immunity across Victoria are consistently high with 46-80% of rabbit populations predicted to survive future RHD outbreaks

Implications of immunity

- Within Victoria further releases of RHD would be limited due to the existing high levels of immunity and frequent recurrence of RHD
- The existing high levels of RHD immunity in conjunction with historically low rabbit populations, highlights the importance of ongoing rabbit control to reduce immune breeding rabbits

Study description

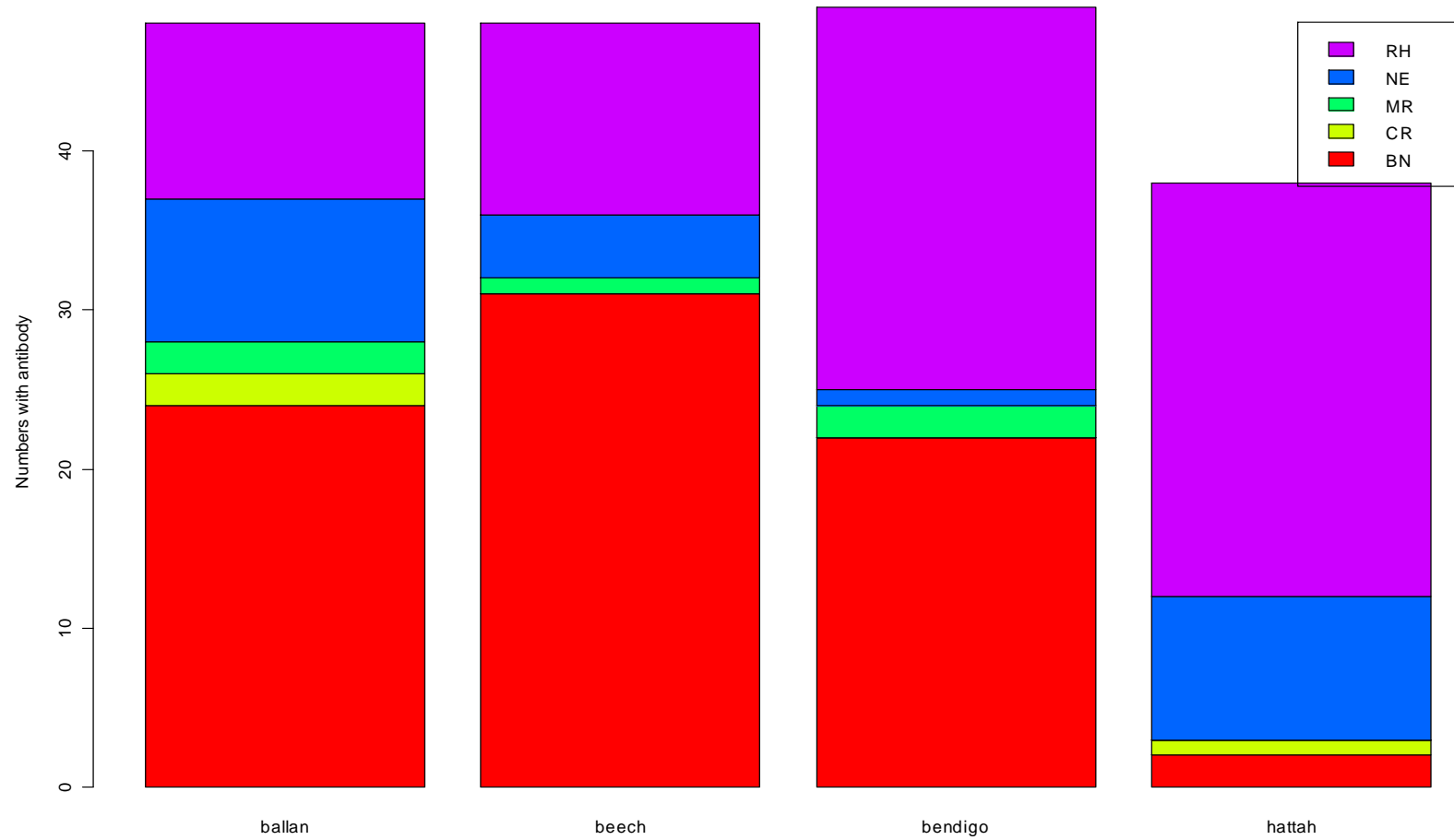
- 188 wild rabbits captured from four locations in Victoria
- After quarantine period, rabbits challenged with a lethal oral dose of RHDV suspension
- Serum samples used to measure antibody status
- cElisa and three isoElisas measured antibody levels:
cElisa, IgG, IgA and IgM

Classification

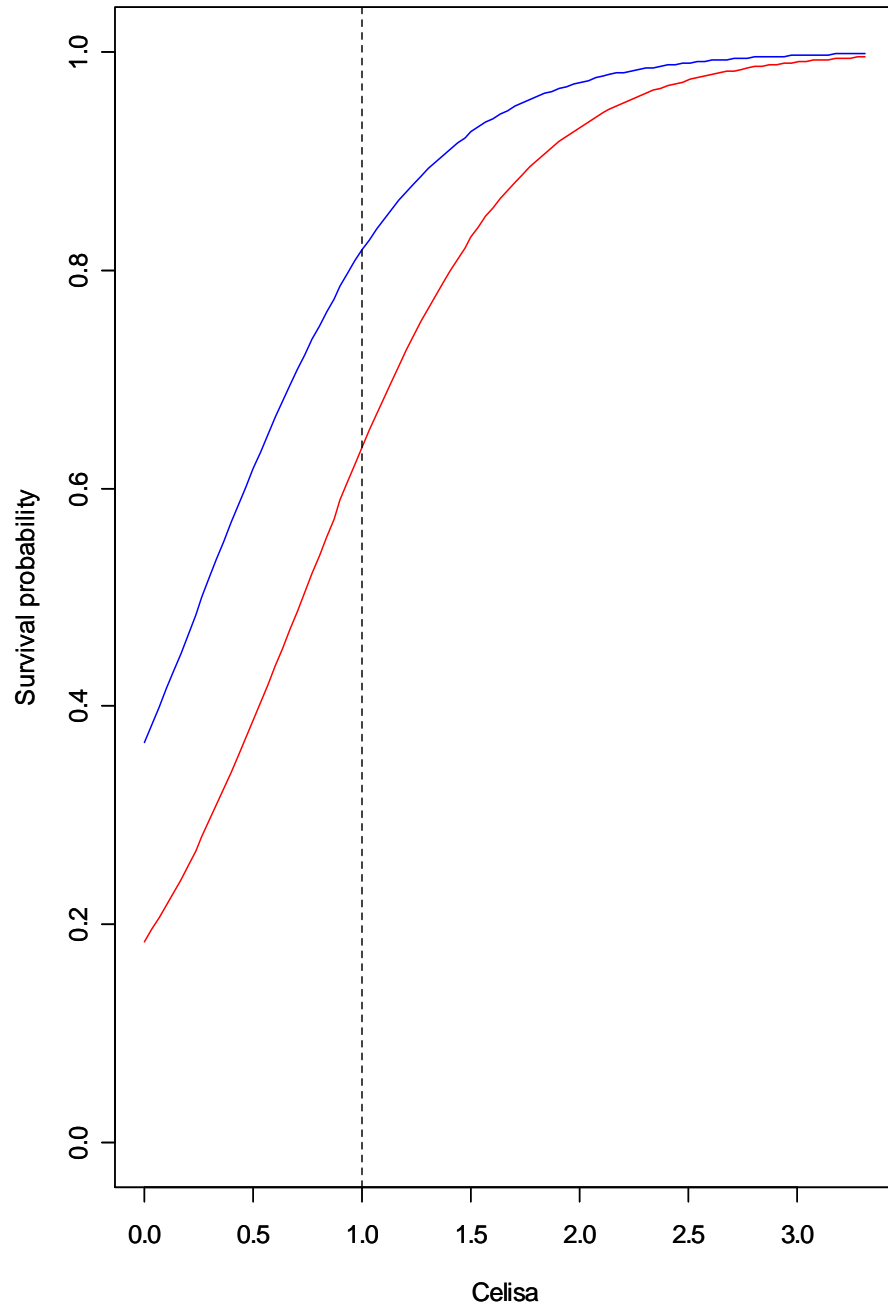
- Rabbits organised into four main antibody classes:
 - Sero-negative, RHDV, maternal RHDV, and bCV
- Antibody classifications determined by cut-off values

Antibody class	cElisa	IgG	IgA	IgM
Sero-negative	<1	<1.3	<1	<1
RHDV	≥1	≥1.3	<1	<1
Maternal RHDV	≥1	≥1.3	<1	<1
bCV	<1	≥1.3	<1	<1

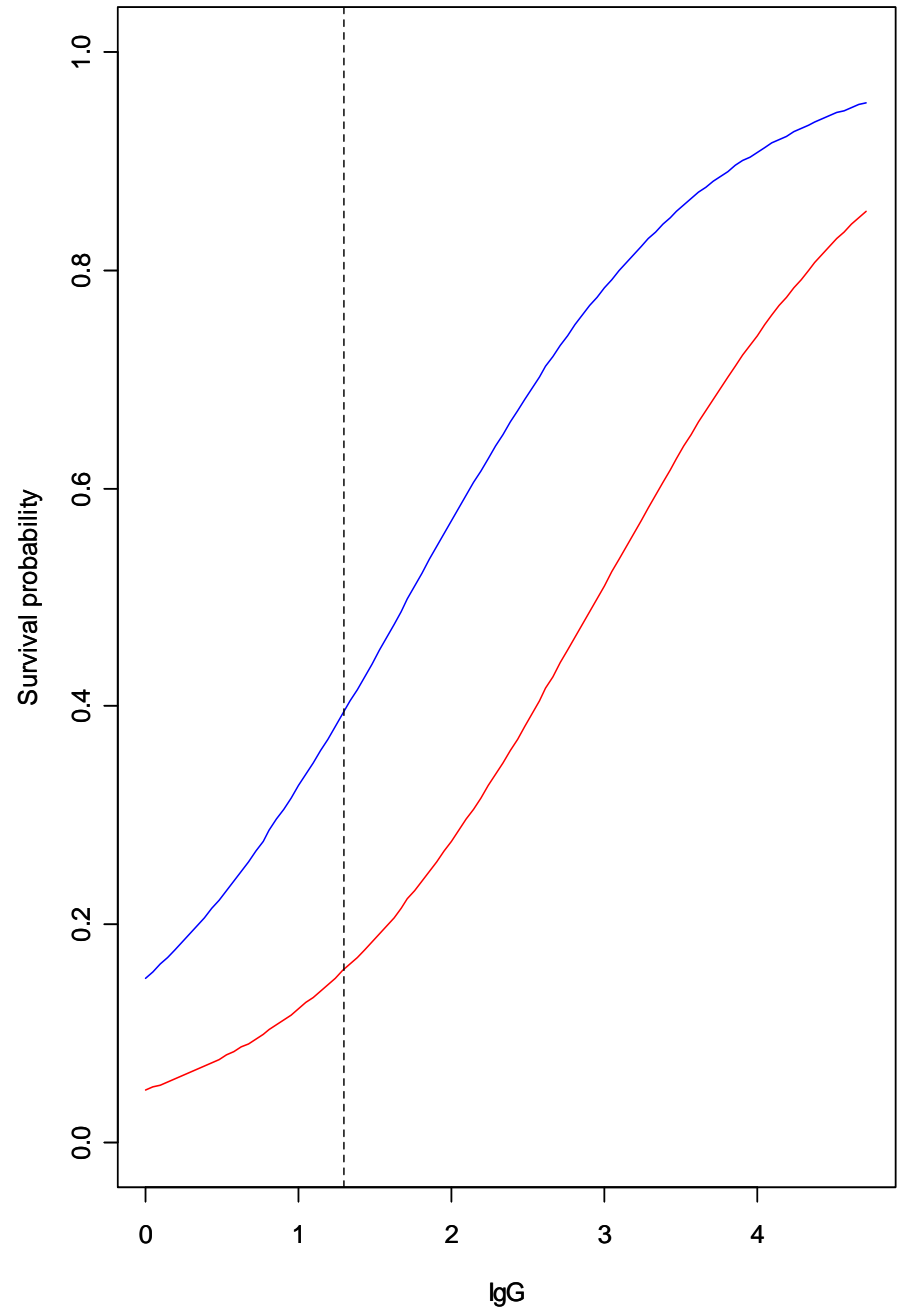
Results



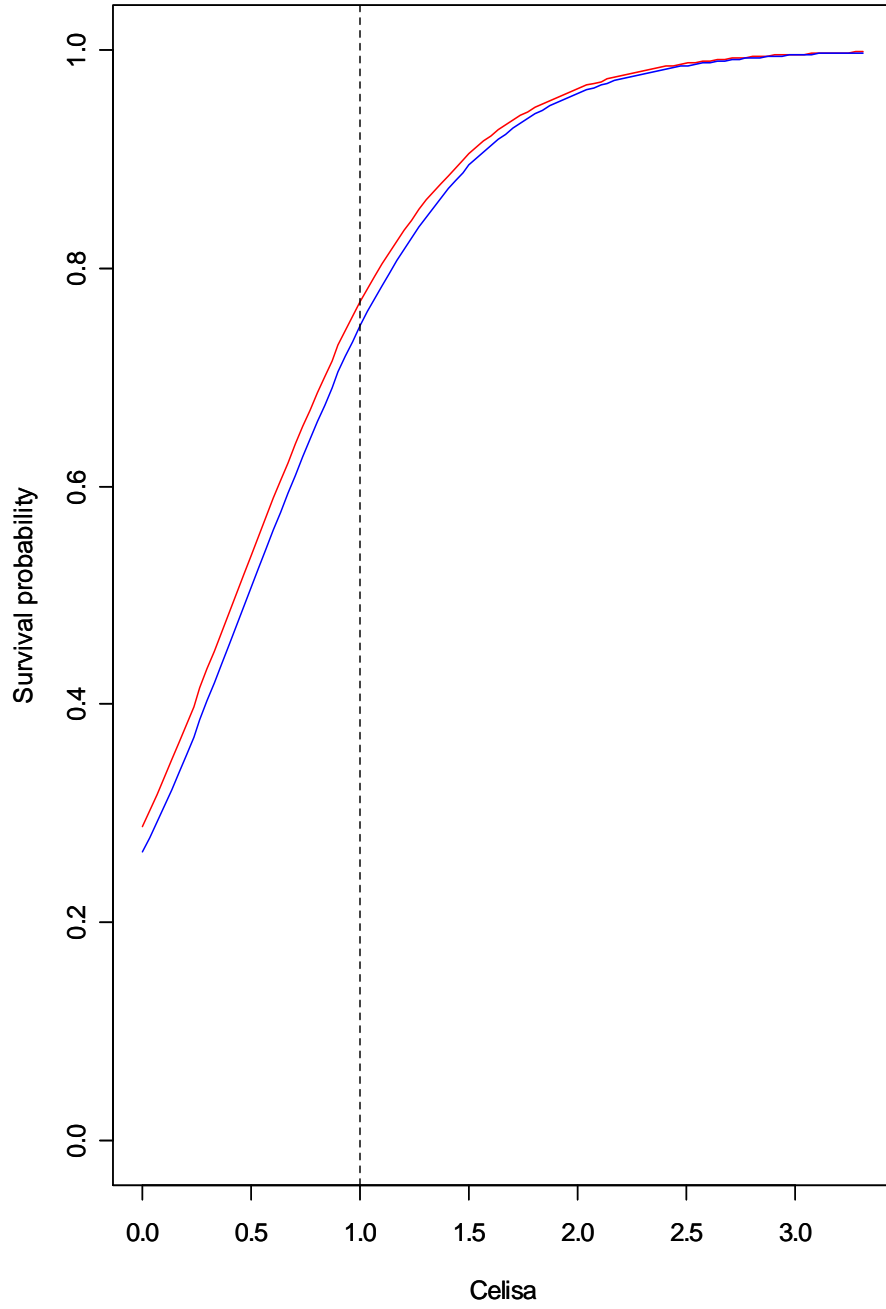
Survival probabilities for age



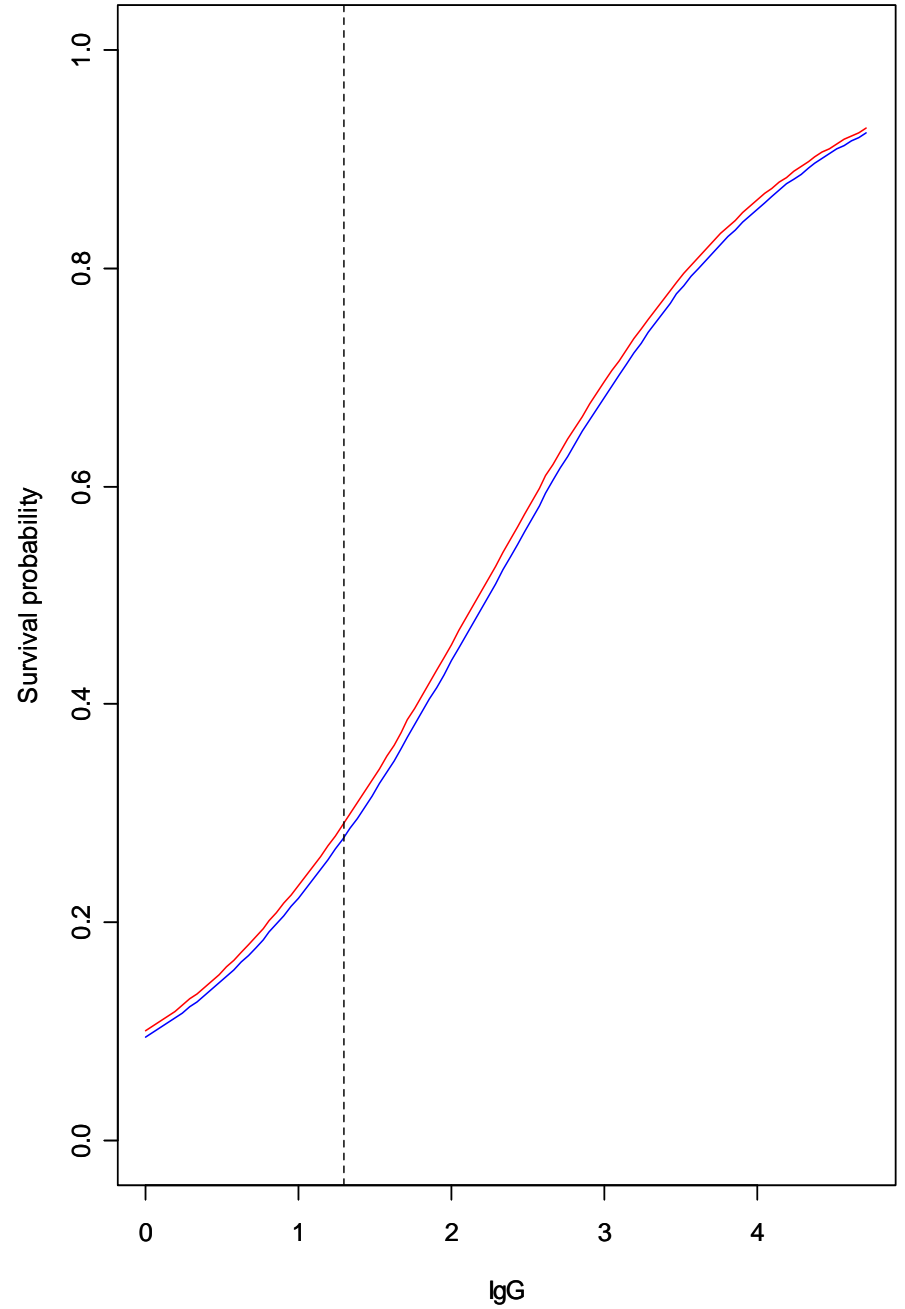
Survival probabilities for age



Survival probabilities for sex



Survival probabilities for sex



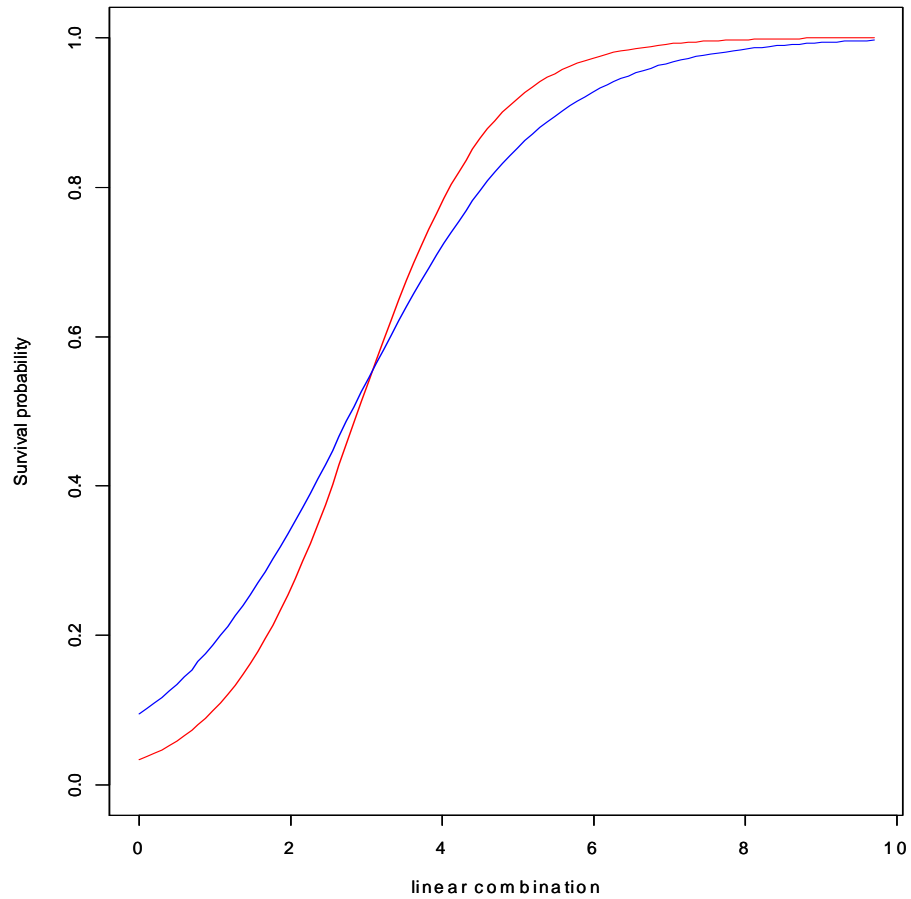
POD models

- Basic idea of POD models

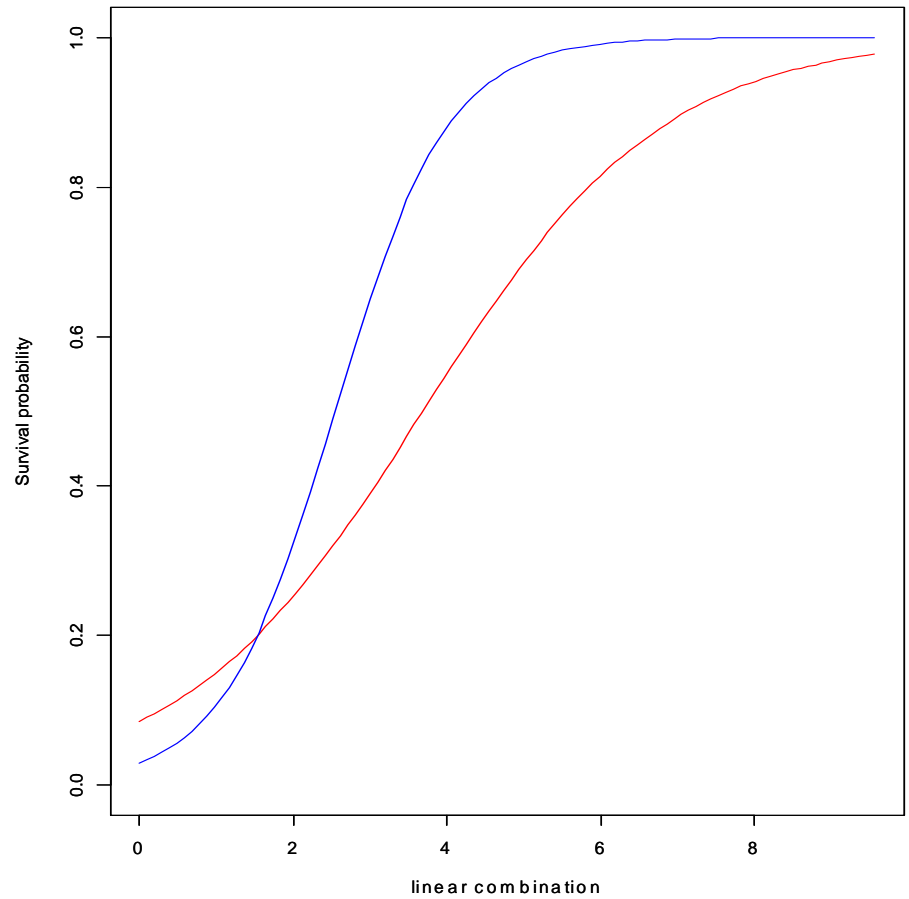
$$Y|(X=x, G=g) \stackrel{d}{=} Y|(\beta X = \beta x, G=g)$$

- POD constructed by replacing the continuous predictors with one linear combination βX

Survival probabilities for sex



Survival probabilities for age



Analysis of Deviance

Model 1: survival ~ taudcelisa + taudigg + sex
 Model 2: survival ~ dbx1 + dbx2 + sex
 Model 3: survival ~ d1bxcelisa + d1bxigg + d2bxcelisa + d2bxigg + sex

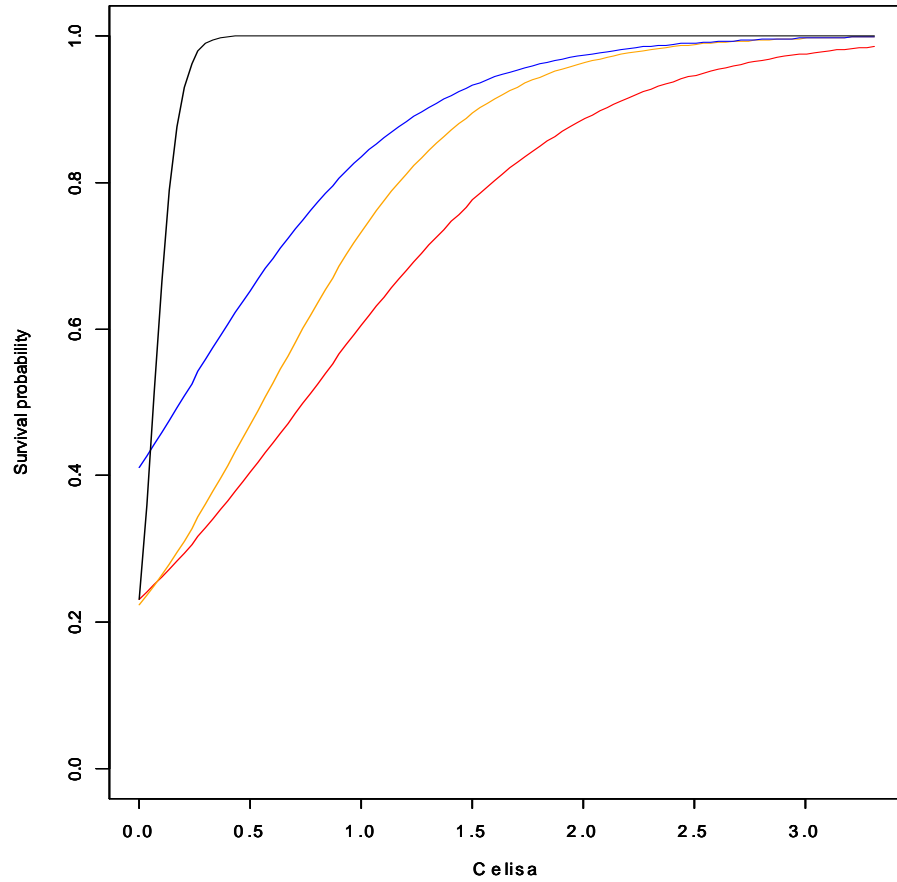
	Resid. Df	Resid. Dev	Df	Deviance
1	179	161.330		
2	179	160.122	0	1.207
3	177	157.396	2	2.726

Analysis of Deviance Table

Model 1: survival ~ taudcelisa + taudigg + age
 Model 2: survival ~ dbx1 + dbx2 + age
 Model 3: survival ~ d1bxcelisa + d1bxigg + d2bxcelisa + d2bxigg + age

	Resid. Df	Resid. Dev	Df	Deviance
1	179	155.086		
2	179	150.544	0	4.542
3	177	150.503	2	0.041

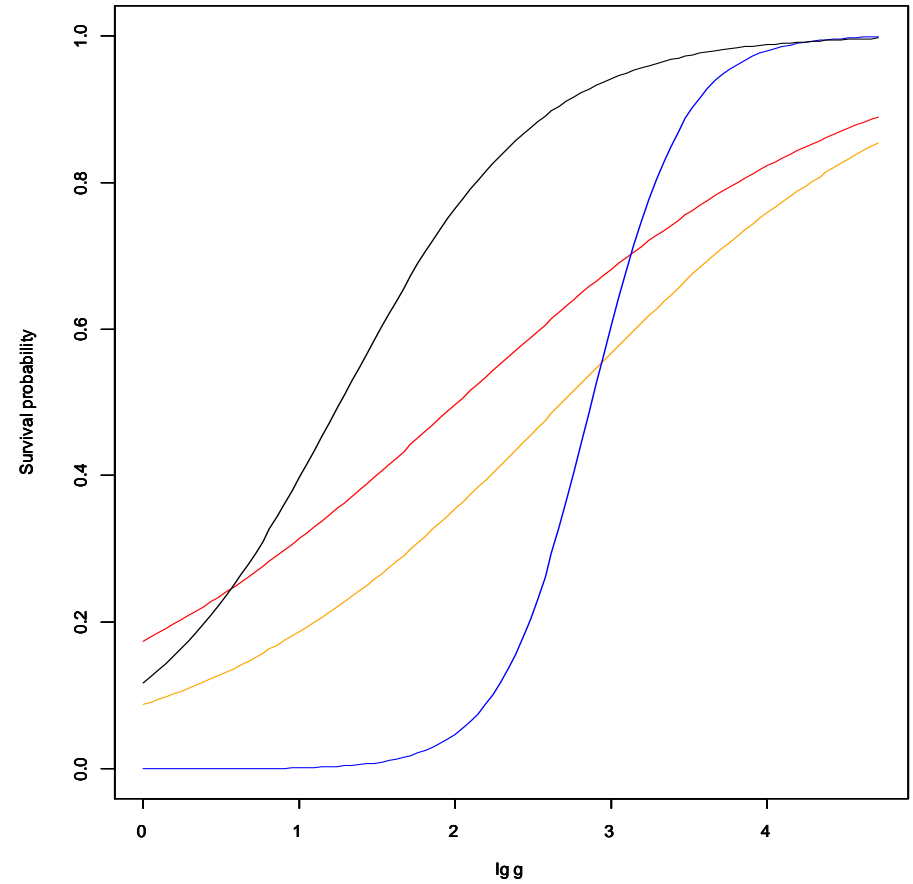
Survival probabilities of sites



Analysis of Deviance

Model 1: survival ~ celisad0 + site
 Model 2: survival ~ d1celisa + d2celisa + d3celisa + d4celisa +site
 Resid. Df Resid. Dev Df Deviance
 1 178 172.447
 2 175 166.084 3 6.362

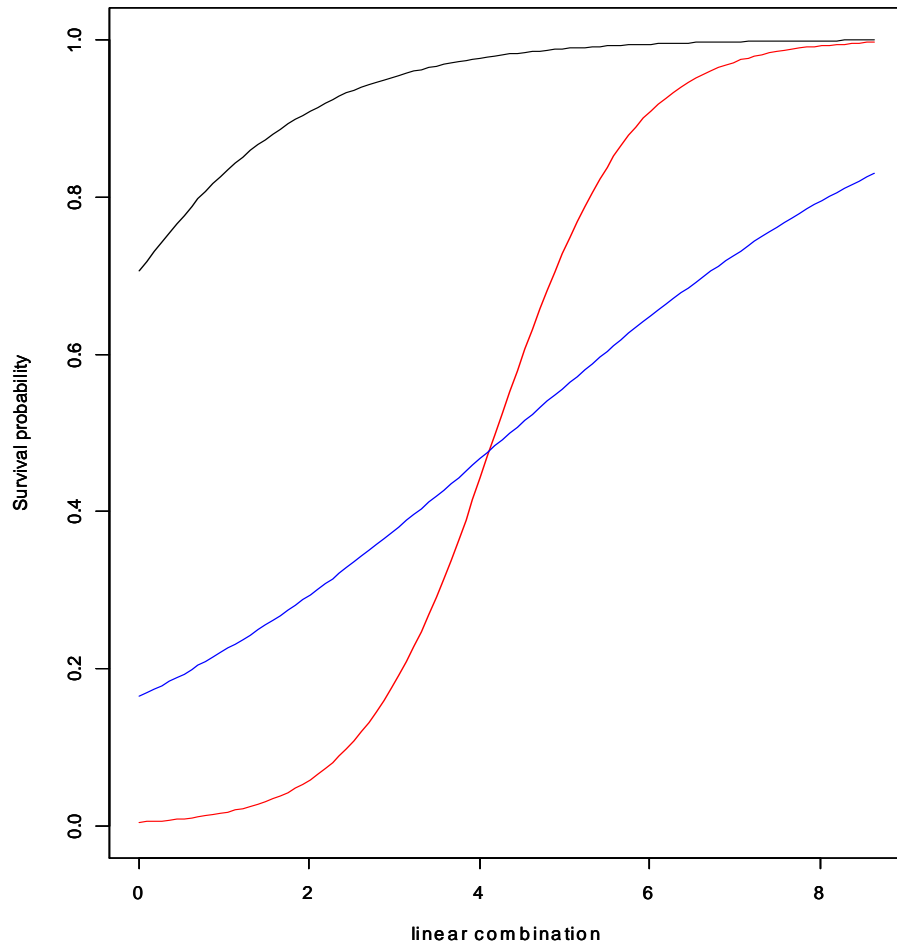
Survival probabilities of sites



Analysis of Deviance

Model 1: survival ~ iggd0 + site
 Model 2: survival ~ d1igg + d2igg + d3igg + d4igg + site
 Resid. Df Resid. Dev Df Deviance
 1 178 190.313
 2 175 180.330 3 9.983

Survival probabilities of nclasses

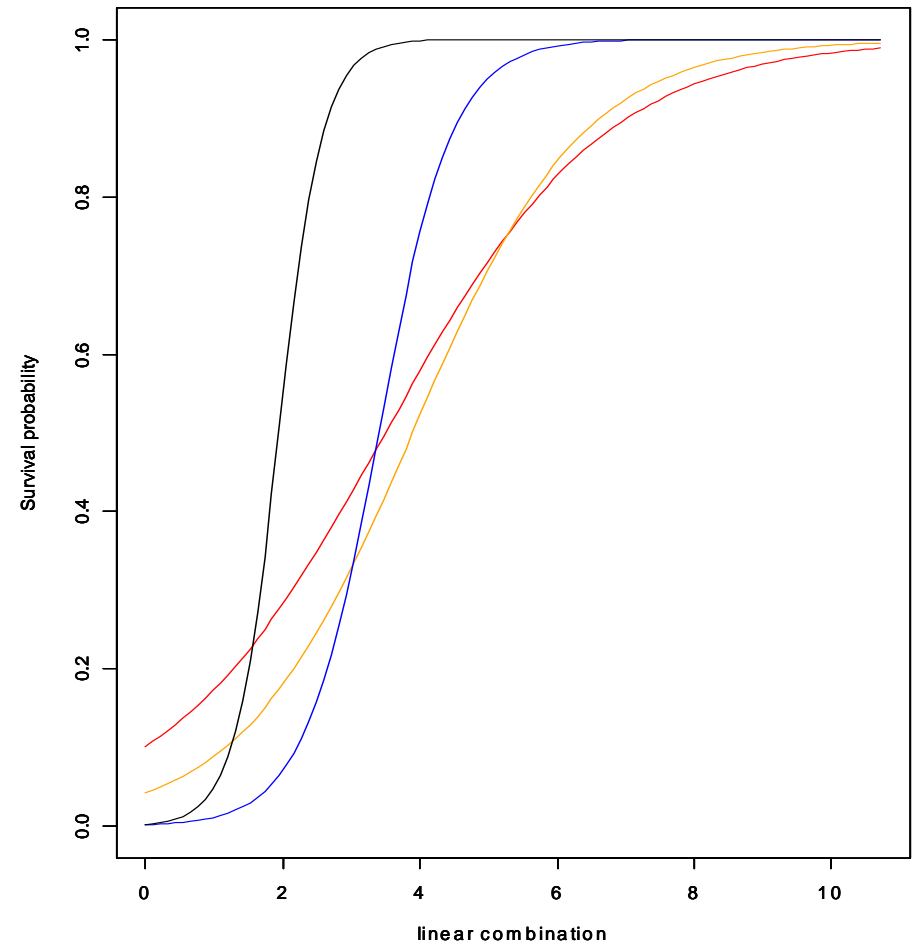


Analysis of Deviance

Model 1: survival ~ taudcelisa + taudigg + nclass
 Model 2: survival ~ dbx1 + dbx2 + dbx3 + nclass
 Model 3: survival ~ d1bxcelisa + d1bxigg + d2bxcelisa +
 d2bxigg + d3bxcelisa + d3bxigg + nclass

	Resid. Df	Resid. Dev	Df	Deviance
1	170	122.005		
2	169	120.314	1	1.692
3	166	118.831	3	1.483

Survival probabilities of sites



Analysis of Deviance

Model 1: survival ~ taudcelisa + taudigg + site
 Model 2: survival ~ dbx1 + dbx2 + dbx3 + dbx4 + site
 Model 3: survival ~ d1bxcelisa + d1bxigg + d2bxcelisa + d2bxigg
 + d3bxcelisa + d3bxigg + d4bxcelisa + d4bxigg + site

	Resid. Df	Resid. Dev	Df	Deviance
1	177	154.088		
2	175	144.522	2	9.566
3	171	135.401	4	9.121

Future Study

- Construct cut-off values using POD models