Homework # 2 Solutions

Biostatistics 210

Your colleague performed a logistic regression model using prior1996 as a predictor.

(1) *Can you verify the association?* Yes, prior to 1995 about 3% of kids died and after 1995 about 2% of kids died. This gives the following output out of a logistic regression

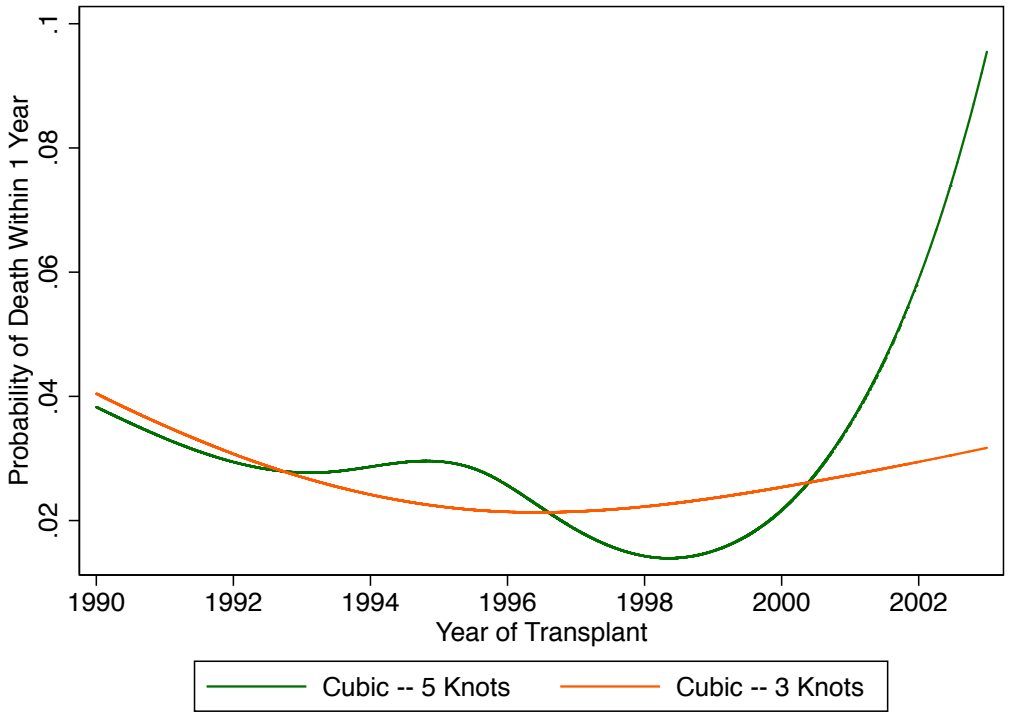
```
. logistic died p

Logistic regression                               Number of obs   =       7949
                                                  LR chi2(1)      =       4.92
                                                  Prob > chi2     =     0.0265
Log likelihood =  -956.9725                       Pseudo R2       =     0.0026

------------------------------------------------------------------------------
        died | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   prior1996 |   1.371822   .1970383     2.20   0.028     1.035232     1.81785
------------------------------------------------------------------------------
```

which is statistically significant. If you adjust for age at transplant and transplant type, then association is nearly unaltered so we are confident that the risk of death is higher in 1995 or earlier compared with 1996 or later.

(2) *Given your colleague's hypothesis, how would you expect the risk of death to change over the years?* It's implicit but not stated that we would expect to see a stable risk of death over the years prior to 1995 that it might decrease as the intervention is rolled out and then perhaps be stable after that. Any other pattern would not fit with the results above.

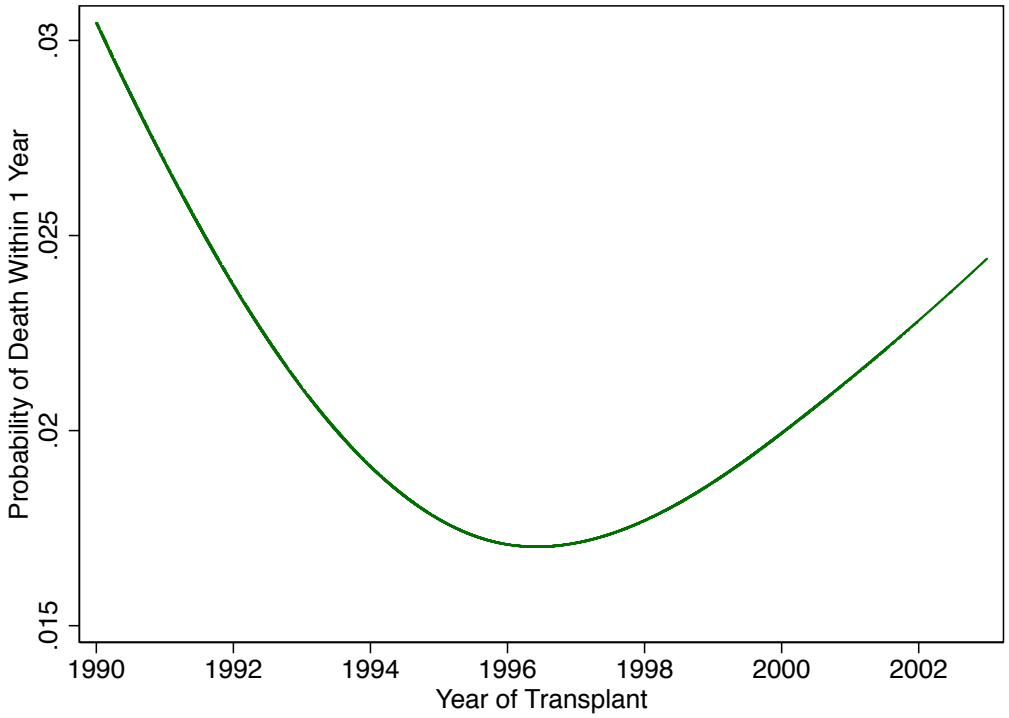
(3) *Explore this using some techniques which discussed. You might also want to make sure you have taken into account factors which have changed over the year (recipient age and living v. cadaveric tx)*. I used a cubic spline fit to year with knots at 1990 1995 and 2000. I also tried a model with 5 knots. Both results appear in Figure 1. Based on this, it looks like mortality was falling prior to 1996 and that it is has increased slightly since then. Let's dwell on this for a moment -- this would appear to contradict the colleague's hypothesis. Even though the risk of death is lower after 1995, that is because of improvements in suvival that precede the intervention which may be driving up mortality. This is a great illustration of how dichotomizing of a continous covariate can be misleading.

Figure 1: Cubic Spline with 3 Knots



The adjusted graph shows the same pattern. This is a bit more work but can be derived as follows

```
mkspline cube_cts = year_cts, cubic knots(1990 1995 2000) displayknots
logistic died cube_cts* age txtype
gen out22 = _b[_cons] + _b[txty]*0.48 +  _b[age]*11.7 +
_b[cube_cts2]*cube_cts2 + _b[cube_cts1]*cube_cts1
gen pr = exp(out22)/(1+exp(out22))
twoway (line pr year_cts, sort), ytitle(Adjusted Probability of Dying in One
Year) xtitle(Calendar Year) scheme(s1color)
```



(4) *Which analysis appears to be the most informative?* The spline fit, preferably the adjusted one is vastly more informative than the binary fit of years. It gives us some sense of how mortality changes flexibly with time.

(5) *Do you conclude that the guideline implementation has improved one year survival*? The implicit hypothesis of improved survival after guideline implementation does not appear to be support**.** We see that mortality fell before the guidelines and may have increased after. Hence, any improvement after 1996 seems to reflect changes that started much early. It is an important lesson in how binary fits have the potential to greatly mislead if taken entirely at face value.