1.

|  |  |  |
| --- | --- | --- |
| Descriptive Statistics | | |
|  | Relapse within | Did not relapse |
|  | 24 months | within 24 months |
| n | 22 | 29 |
| Lowest post-therapy | 31.94 | 4.12 |
| PSA (ng/ml) | (52.50) | (17.28) |
| Prior therapy | 732.35 | 617.19 |
| PSA (ng/ml) | (1357.34) | (1252.08) |
| Performance status | 76.5 | 83.93 |
|  | (11.82) | (9.56) |
| Bone scan score | 2.8 | 2.32 |
|  | (.41) | (.77) |
| Tumor grade | 2.24 | 2.08 |
|  | (.75) | (.83) |
| Age | 68.36 | 66.71 |
|  | (5.68) | (5.84) |

2.

a.

logistic relap24 bss ps nadir

Logistic regression Number of obs = 48

LR chi2(3) = 15.10

Prob > chi2 = 0.0017

Log likelihood = -25.052835 Pseudo R2 = 0.2315

------------------------------------------------------------------------------

relap24 | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

bss | 2.624249 1.65688 1.53 0.126 .7613409 9.045463

ps | .9522044 .0314029 -1.49 0.138 .892603 1.015786

nadir | 1.033877 .0242646 1.42 0.156 .9873965 1.082545

\_cons | 2.07229 6.585929 0.23 0.819 .0040856 1051.108

**For patients with the same bone scan score and performance score, a 1 ng/ml increase in post therapy PSA was associated with a 1.04 fold increase in the odds of cancer relapse within 24 months, however, this result was not significant at the 5% level.**

b.

logistic relap24 bss ps lnadir

Logistic regression Number of obs = 48

LR chi2(3) = 28.17

Prob > chi2 = 0.0000

Log likelihood = -18.518315 Pseudo R2 = 0.4320

------------------------------------------------------------------------------

relap24 | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

bss | 2.345473 1.92422 1.04 0.299 .4697933 11.70992

ps | .9490084 .0347574 -1.43 0.153 .8832728 1.019636

lnadir | 2.362528 .6142753 3.31 0.001 1.419247 3.932745

\_cons | 3.060676 11.40023 0.30 0.764 .0020669 4532.354

Ln(1.10)\*2.365=1.252

**For patients with the same bone scan score and performance score, a 10 percent increase in post therapy PSA was associated with an approximately 25% increase in the odds of cancer relapse within 24 months, and this result was significant at the 10% level.**

c.

logistic relap24 bss ps nadir1-nadir4

Logistic regression Number of obs = 48

LR chi2(6) = 31.17

Prob > chi2 = 0.0000

Log likelihood = -17.01874 Pseudo R2 = 0.4780

------------------------------------------------------------------------------

relap24 | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

bss | 2.52226 2.294262 1.02 0.309 .424162 14.9985

ps | .9367181 .0385458 -1.59 0.112 .864136 1.015397

nadir1 | 29.61699 56.15361 1.79 0.074 .7205578 1217.343

nadir2 | .9034492 .5289488 -0.17 0.862 .2867773 2.846182

nadir3 | 1.379926 .3083346 1.44 0.150 .890555 2.138211

nadir4 | .9818103 .0175701 -1.03 0.305 .9479706 1.016858

\_cons | .5070437 2.051823 -0.17 0.867 .0001822 1411.08

. test nadir1 nadir2 nadir3 nadir4

( 1) [relap24]nadir1 = 0

( 2) [relap24]nadir2 = 0

( 3) [relap24]nadir3 = 0

( 4) [relap24]nadir4 = 0

chi2( 4) = 11.05

Prob > chi2 = 0.0260

**MARGINAL EFFECTS**

logistic relap24 bss ps nadir\_1-nadir\_4

Logistic regression Number of obs = 48

LR chi2(6) = 31.17

Prob > chi2 = 0.0000

Log likelihood = -17.01874 Pseudo R2 = 0.4780

------------------------------------------------------------------------------

relap24 | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

bss | 2.52226 2.294262 1.02 0.309 .424162 14.9985

ps | .9367181 .0385458 -1.59 0.112 .864136 1.015397

nadir\_1 | 29.61699 56.15361 1.79 0.074 .7205578 1217.343

nadir\_2 | .0305044 .0683472 -1.56 0.119 .0003777 2.463406

nadir\_3 | 1.527397 1.157883 0.56 0.576 .345682 6.748809

nadir\_4 | .7114951 .1679874 -1.44 0.149 .4479187 1.130172

\_cons | .5070437 2.051823 -0.17 0.867 .0001822 1411.08

------------------------------------------------------------------------------

**This model is a little harder to interpret. For patients with the same bone scan score and performance score, a 1 ng/ml increase in post therapy PSA was associated with a 29.6 fold increase in the odds of cancer relapse within 24 months when just looking at PSA tests which gave a result between 0 and 1 ng/ml. The odds of relapse decreased by .9 fold for each 1 ng/ml PSA test increase when the test gave results between 1 and 4. The odds of relapse increased by 1.38 fold for each 1 ng/ml PSA test increase when the test gave results between 4 and 16. The odds of relapse decreased by .98 fold for each 1 ng/ml PSA test increase when the test gave results greater than 16.**

**None of the individual splines were significant at the 5% level, however they were all jointly significant at the 5% level giving evidence that increases in PSA level are associated with an increased odds of relapse across all the data.**

**Based on the marginal effects, there is little evidence to conclude from that using 4 as a cutoff makes a lot of sense, because the odds of relapse do not appear to significantly increase of a PSA test value above 4 ng/ml.**

2d

**Model 1 – For those with a Performance score of 0, a bone scan score of 0 (not even possible), and a PSA test level of 0, the chances of relapsing are 2.07 times the chances of not relapsing, but this result is not significant at the 5% level. This intercept has no real useful interpretive value.**

**Model 2 – For those with a Performance score of 0, a bone scan score of 0 (not even possible), and a PSA test level of 0, the chances of relapsing are 3.06 times the chances of not relapsing, but this result is not significant at the 5% level. This intercept has no real useful interpretive value.**

**Model 3 – For those with a Performance score of 0, a bone scan score of 0 (not even possible), and a PSA test level which doesn’t fit in any of the 4 PSA test spline categories (also not possible), the chances of relapsing are .51 times the chances of not relapsing, but this result is not significant at the 5% level. This intercept has no real useful interpretive value.**

3a

regress nadir bss ps relap24

Source | SS df MS Number of obs = 48

-------------+------------------------------ F( 3, 44) = 3.19

Model | 13423.353 3 4474.45099 Prob > F = 0.0327

Residual | 61722.4418 44 1402.78277 R-squared = 0.1786

-------------+------------------------------ Adj R-squared = 0.1226

Total | 75145.7948 47 1598.8467 Root MSE = 37.454

------------------------------------------------------------------------------

nadir | Coef. Std. Err. t P>|t| [95% Conf. Interval]

-------------+----------------------------------------------------------------

bss | 6.84555 8.591398 0.80 0.430 -10.46927 24.16038

ps | -.5099777 .5274323 -0.97 0.339 -1.572948 .5529922

relap24 | 23.51765 12.18454 1.93 0.060 -1.038675 48.07398

\_cons | 31.0281 51.26774 0.61 0.548 -72.29523 134.3514

**For patients with the same bone scan score and performance score, those who did relapse before 24 months had an average PSA test score 23.52 points higher than those who did not relapse. This result was not significant at the 5% level (p=.06). Holding all else constant, a one level increase in bone scan score was associated with a 6.85 ng/ml increase in PSA score, and a 1 unit increase in performance score was associated with a .51 unit decrease in PSA score, but neither of these were significant at the 5% level.**

B

regress lnadir ps bss relap24

Source | SS df MS Number of obs = 48

-------------+------------------------------ F( 3, 44) = 12.55

Model | 103.036842 3 34.345614 Prob > F = 0.0000

Residual | 120.438498 44 2.73723858 R-squared = 0.4611

-------------+------------------------------ Adj R-squared = 0.4243

Total | 223.47534 47 4.75479446 Root MSE = 1.6545

------------------------------------------------------------------------------

lnadir | Coef. Std. Err. t P>|t| [95% Conf. Interval]

-------------+----------------------------------------------------------------

ps | -.0072296 .0232985 -0.31 0.758 -.0541847 .0397254

bss | .4817541 .3795115 1.27 0.211 -.2831011 1.246609

relap24 | 2.614223 .5382329 4.86 0.000 1.529485 3.69896

\_cons | -1.166384 2.264672 -0.52 0.609 -5.730531 3.397762

**For patients with the same bone scan score and performance score, those who did relapse before 24 months had 2.61 times the** **PSA test score as those who did not relapse. This result was significant at the 5% level (p<.0005). Holding all else equal, changes in performance score or bone scan score were not associated with chages in the geometric mean of the PSA test score.**

4a

**Model 1- Allows you to test whether absolute changes in PSA score affect relapse rate**

**Model 2 – Allows you to test whether changes in PSA score affect relapse rate on a logarithmic scale.**

**Model 3 – Allows you to test whether absolute changes in PSA score have differential affects along the PSA test spectrum. In this instance, it could be used to evaluate whether it makes sense to use a PSA test cutoff of 4 ng/ml to call a test positive or negative.**

**Model 4 – Test whether there are absolute differences in PSA levels in those who did and did not relapse.**

**Model 5 – Test whether there are relative logarithmic differences in PSA levels in those who did and did not relapse.**

**A priori, I would have probably chosen model 2. I would expect PSA scores to behave like other biomarkers predicative of disease and have their effects most accurately depicted on a logarithmic scale. I would also choose to do the PSA test predicting disease model because that is the model we are interested in using in real life. Using test results to predict disease using information available before relapse has occurred.**

B

**Hmm, if I had to guess, lowest PSA obtained post therapy seems like a strange variable to use. It seems there should have been a uniform way of doing post therapy PSA tests. Some people may have had many more tests, and the time of follow-up might change dramatically. It seems this could be a significant problem.**