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ERHS 632: Applied Logistic Regression

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Homework 6

Table 1:Frequencies and relative frequencies of the categorical study variables by Status

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Level | STA | | NO STA | |
|  |  | Frequency | Percent | Frequency | Percent |
| Gender | MALE | 30 | 65.22 | 104 | 67.53 |
|  | FEMALE | 16 | 34.78 | 50 | 32.47 |
|  | TOTAL | 46 | 100 | 154 | 100 |
|  |  |  |  |  |  |
| RACE | WHITE | 44 | 87.66 | 135 | 87.66 |
|  | BLACK | 12 | 7.79 | 12 | 7.79 |
|  | OTHER | 7 | 4.55 | 7 | 4.55 |
|  | TOTAL | 63 | 100 | 154 | 100 |
|  |  |  |  |  |  |
| Service at ICU Admission | MEDICAL | 32 | 69.57 | 56 | 36.36 |
|  | SURGICAL | 14 | 30.43 | 98 | 63.64 |
|  | TOTAL | 46 | 100 | 154 | 100 |
|  |  |  |  |  |  |
| Cancer Part of present Problem | YES | 6 | 13.04 | 16 | 10.39 |
|  | NO | 40 | 86.96 | 138 | 89.61 |
|  | TOTAL | 46 | 100 | 154 | 100 |
|  |  |  |  |  |  |
| History of Chronic Renal Failure | YES | 11 | 23.91 | 5 | 3.25 |
|  | NO | 35 | 76.09 | 149 | 96.75 |
|  | TOTAL | 46 | 100 | 154 | 100 |
|  |  |  |  |  |  |
| Infection Probable at ICU Admission | YES | 97 | 62.99 | 29 | 63.04 |
|  | NO | 57 | 37.01 | 17 | 36.96 |
|  | TOTAL | 154 | 100 | 46 | 100 |
|  |  |  |  |  |  |
| CPR Prior to ICU Admission | YES | 5 | 3.25 | 8 | 17.39 |
|  | NO | 149 | 96.75 | 38 | 82.61 |
|  | TOTAL | 154 | 100 | 46 | 100 |
|  |  |  |  |  |  |
| Previous Admission to an ICU within 6 Months | YES | 6 | 13.04 | 17 | 11.04 |
|  | NO | 40 | 86.96 | 137 | 88.96 |
|  | TOTAL | 46 | 100 | 154 | 100 |
| Table 1: Continued |  |  |  |  |  |
|  |  |  |  |  |  |
| Type of AdmissionE OF ADMISSION | ELECTIVE | 4 | 8.7 | 53 | 34.42 |
|  | EMERGENCY | 42 | 91.3 | 42 | 91.3 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| Long Bone, multiple, neck, single area, or hip fracture | YES | 5 | 10.87 | 12 | 7.79 |
|  | NO | 41 | 89.13 | 142 | 92.21 |
|  | TOTAL | 46 | 100 | 154 | 100 |
|  |  |  |  |  |  |
| PO2 from initial blood gases | >60 | 36 | 78.26 | 144 | 93.51 |
|  | <=60 | 10 | 21.74 | 10 | 6.49 |
|  | TOTAL | 46 | 100 | 154 | 100 |
|  |  |  |  |  |  |
| PH from initial blood gases | >= 7.25 | 147 | 95.45 | 42 | 91.3 |
|  | <7.25 | 7 | 4.55 | 4 | 8.7 |
|  | TOTAL | 154 | 100 | 46 | 100 |
|  |  |  |  |  |  |
| PCO2 from initial blood gases | <=45 | 40 | 86.96 | 146 | 94.81 |
|  | >45 | 6 | 13.04 | 8 | 5.19 |
|  | TOTAL | 46 | 100 | 154 | 100 |
|  |  |  |  |  |  |
| Bicarbonate from initial blood gases | >= 18 | 42 | 91.3 | 145 | 94.16 |
|  | <18 | 9 | 5.84 | 9 | 5.84 |
|  | TOTAL | 51 | 97.14 | 154 | 100 |
|  |  |  |  |  |  |
| Creatinine from Initial Blood Gases | <=2.0 | 40 | 86.96 | 149 | 96.75 |
|  | >2.0 | 6 | 13.04 | 5 | 3.25 |
|  | TOTAL | 46 | 100 | 154 | 100 |
|  |  |  |  |  |  |
| Level of Consciousness at ICU admission | NO COMA | 31 | 67.39 | 153 | 99.35 |
|  | DEEP STUPOR | 5 | 10.87 | 0 | 0 |
|  | COMA | 10 | 21.74 | 1 | 0.65 |

Table 1 Summary

Gender:

* No sparse cells
* Higher proportion of Mles

RACE:

* Possible low frequency for Other in Sta/No STA
* Need to create design variables
* Mostly white Race

Service at ICU admission:

* No Sparse cells
* Medical admission more likely to have STA

Cancer Part of Present Problem

* Possible Sparse Cells in Yes/STA
* Majority NO cancer as part of present problem

History of Chronic Renal Failure

* Sparse Cell in Yes/No STA

Infection Probable at ICU Admission

* No Sparse cells

CPR Prior to ICU admission

* One Sparse Cell Potentially 2 (8)

Previous Admission to an ICU with 6 months

* One Sparse Cell

Type of Admission

* Sparse Cell in Elective/STA

Long Bone, multiple neck, single area, or hip fracture

* One Sparse cell. Yes/STA

PO2 from initial blood gases from initial blood gases

* No sparse cells

PO2 from initial blood gases from initial blood gases

* 1 definite sparse cell. Potentially 2

PCO2 fro initial blood gases from initial blood gases

* 2 potential sparse cells in >45 Yes/No

Bicarbonate from initial blood gases

* No sparse cells

Creatinine from initial blood gases

* Sparse cellse in >2.0 Cells

Level of Consciousness at ICU admission

* Sparse and 0 cell present

Table 2: Descriptive Statistics of continuous variables by Status

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **AGE** | | **Systolic Blood Pressure (mm Hg)** | | **Heart Rate at ICU Admission (Beats/min)** | |
|  | LIVED | DIED | LIVED | DIED | LIVED | DIED |
| Mean | 55.8 | 69.6 | 134.1 | 115.3 | 97.5 | 104 |
| Std | 20 | 14.1 | 31.1 | 38 | 28.3 | 25.8 |
| Min | 16 | 20 | 48 | 36 | 39 | 55 |
| 1st Quartile | 46 | 63 | 112 | 80 | 79 | 81 |
| Median | 62 | 69.5 | 132 | 112 | 90.5 | 96 |
| 3rd Quartile | 71 | 78 | 150 | 136 | 118 | 124 |
| Maximum | 91 | 92 | 224 | 256 | 192 | 160 |
| Lowest Values | 16, 17, 17, 17, 17 | 20, 40, 50, 50, 55 | 48, 68, 68, 78, 78 | 36, 62, 64, 66, 80 | 39, 48, 48, 48, 52 | 55, 64, 66, 72, 80 |
| Highest Values | 83, 84, 87, 87, 91 | 88, 88, 91, 92, 92 | 206, 208, 208, 224, 224 | 150, 168, 168, 190, 256 | 154, 154, 162, 192, 192 | 140, 145, 150, 150, 160 |

Table 2 Summary

Age

* No Obvious Outliers
* People at older ages more likely to have died

Systolic Blood Pressure

* No obvious outliers except 256 is Died Blood pressure
* Keep for now

Heart Rate at ICU Admission

* No obvious outliers
* There are 154 participants who lived and 46 participants who died
* Least frequent outcome divided by 10 = 46/10 ≈ 5
* Model should not contain more than about 5 covariates

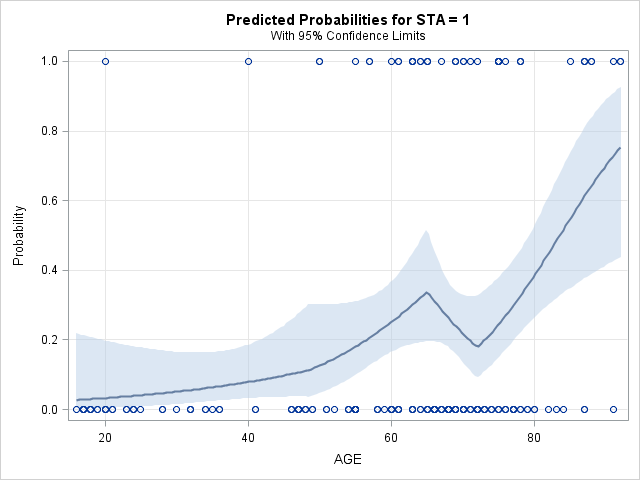
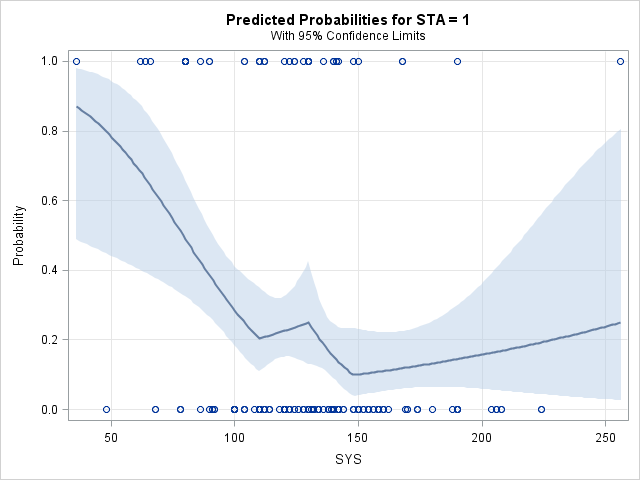
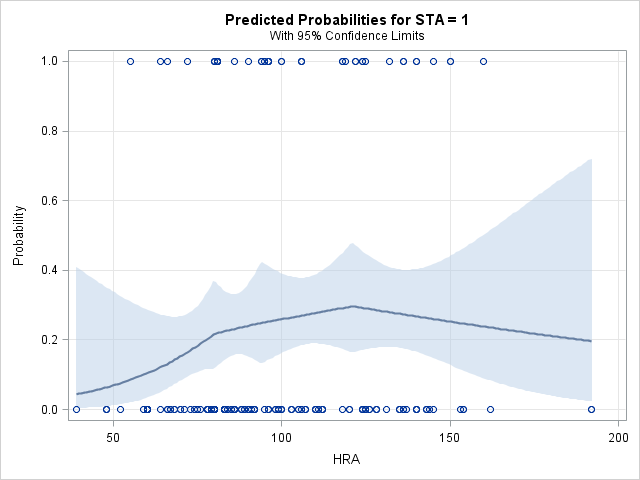
  

Figure 1: Spline effect plots= 1st quartile, median, and 3rd Quartile; Linear Connection.

Consider Transforming SYS:

Creating new categories for now:

SYSa = 0 if 16<= or >110

SYSa = 1 if 110<=or >150

SYSa= 2 if >=150

Table 3: Univariate Logistic Regression Results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Comparison/Unit | OR | 95% CI | | P-value |
| GENDER | Female Vs Male | 1.109 | 0.554 | 2.221 | 0.769 |
|  |  |  |  |  |  |
| RACE1 | Black vs White | 0.256 | 0.032 | 2.023 | 0.196 |
|  | Other vs White | 0.438 | 0.052 | 3.662 | 0.446 |
|  |  |  |  |  |  |
| Service at ICU admission: | Yes vs No | 0.25 | 0.123 | 0.508 | 0.0001 |
|  |  |  |  |  |  |
| Cancer part of the present problem | Yes vs No | 1.294 | 0.475 | 3.524 | 0.614 |
|  |  |  |  |  |  |
| History of chronic renal failure | Yes vs No | 9.37 | 3.058 | 28.687 | <.0001 |
|  |  |  |  |  |  |
| Infection Probable at ICU admission | Yes vs No | 2.903 | 1.467 | 5.743 | 0.002 |
|  |  |  |  |  |  |
| CPR | Yes vs No | 6.272 | 1.941 | 20.263 | 0.002 |
|  |  |  |  |  |  |
| Previous admision to an ICU within 6 months | Yes vs No | 1.209 | 0.447 | 3.27 | 0.709 |
|  |  |  |  |  |  |
| Type of Admission | Yes vs No | 5.51 | 1.875 | 16.194 | 0.0019 |
|  |  |  |  |  |  |
| Long bone, multiple, neck, single area, or hip fracture | Yes vs No | 1.443 | 0.481 | 4.334 | 0.5131 |
|  |  |  |  |  |  |
| PO2 from initial blood gases | <=60 vs >60 | 4 | 1.548 | 10.34 | 0.004 |
|  |  |  |  |  |  |
| PO2 from initial blood gases | <7.25 vs >=7.25 | 2 | 0.559 | 7.161 | 0.287 |
|  |  |  |  |  |  |
| PCO | >45 vs <=45 | 2.738 | 0.898 | 8.347 | 0.0766 |
|  |  |  |  |  |  |
| Bicarbonate from initial blood gases | <18 vs >=18 | 1.535 | 0.45 | 5.234 | 0.493 |
|  |  |  |  |  |  |
| Creatinine from initial blood gases | >2.0 vs <=2.0 | 4.47 | 1.297 | 15.401 | 0.0177 |
|  |  |  |  |  |  |
| Level of consciousness at ICU admission2 | Deep Coma vs No Coma | >999.999 | <0.001 | >999.999 | 0.9768 |
|  | Coma vs No Coma | 49.355 | 6.095 | 399.653 | 0.0003 |
|  |  |  |  |  |  |
| Table 3 continued |  |  |  |  |  |
| Systolic blood pressure at ICU admission3 | >=110 to <150 vs <110 | 0.41 | 0.191 | 0.881 | 0.022 |
|  | <=150 vs <110 | 0.171 | 0.056 | 0.52 | 0.0019 |
|  |  |  |  |  |  |
| AGE | 10 | 1.643 | 1.278 | 2.111 | 0.0001 |
|  |  |  |  |  |  |
| Heart Rate at ICU admission | 40 | 1.386 | 0.871 | 2.208 | 0.1686 |

1Likelihood ratio test p-value = 0.225

Non-significant variables (p>=0.25)

* Gender
* Race
* CAN
* PRE
* FRA
* PH
* BIC
* LOC (Insufficient cells)
* HRA

Significant variables (p<0.25)

* SER
* CRN (Sparse Cells)
* INF
* CPR (Large CI)
* TYP
* PO2
* PCO
* CRE
* SYS
* AGE

2Likelihood ratio test p-value = 0.0013

3Likelihood ratio test p-value = 0.0031

Summary Table 3

Table 4a: Multivariate logistic regression results – Initial main effects model (contains variables significant at the 0.25 level in univariate analyses)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Comparison/Unit | OR | 95% CI | | P-value |
| Service at ICU admission: | Yes vs No | 0.499 | 0.18 | 1.386 | 0.1823 |
| History of chronic renal failure | Yes vs No | 5.09 | 1.347 | 15.858 | 0.0149 |
| Infection Probable at ICU admission | Yes vs No | 0.824 | 0.325 | 2.086 | 0.6828 |
| CPR | Yes vs No | 4.585 | 1.053 | 19.972 | 0.0425 |
| Type of Admission | Yes vs No | 2.126 | 0.525 | 8.606 | 0.2906 |
| PO2 from initial blood gases | <=60 vs >60 | 2.017 | 0.563 | 7.226 | 0.2815 |
| PCO | >45 vs <=45 | 0.957 | 0.202 | 4.527 | 0.9554 |
| Creatinine from initial blood gases | >2.0 vs <=2.0 | 1.411 | 0.27 | 7.39 | 0.6834 |
| Systolic blood pressure at ICU admission | >=110 to <150 vs <110 | 0.632 | 0.231 | 1.278 | 0.3717 |
|  | <=150 vs <110 | 0.233 | 0.06 | 0.903 | 0.0351 |
| AGE | 10 | 1.697 | 1.253 | 2.297 | 0.0006 |

History of chronic renal failure has sparse cells. Re-run without History of chronic renal failure

Table 4b: Multivariate model with History of chronic renal failure removed

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Comparison/Unit | OR | | 95% CI | | | P-value |
| Service at ICU admission: | Yes vs No | | 0.481 | | 0.181 | 1.283 | 0.144 |
| Infection Probable at ICU admission | Yes vs No | | 0.954 | | 0.391 | 2.33 | 0.9183 |
| CPR | Yes vs No | | 4.216 | | 1.021 | 17.406 | 0.0467 |
| Type of Admission | Yes vs No | | 2.544 | | 0.65 | 9.949 | 0.1797 |
| PO2 from initial blood gases | <=60 vs >60 | | 2.208 | | 0.622 | 7.838 | 0.2203 |
| PCO | >45 vs <=45 | | 0.689 | | 0.148 | 3.218 | 0.6359 |
| Creatinine from initial blood gases | >2.0 vs <=2.0 | | 2.094 | | 0.464 | 9.442 | 0.3363 |
| Systolic blood pressure at ICU admission | >=110 to <150 vs <110 | | 0.622 | | 0.236 | 1.638 | 0.3362 |
|  | <=150 vs <110 | | 0.251 | | 0.07 | 0.899 | 0.338 |
| AGE | 10 | | 1.723 | | 1.28 | 2.319 | 0.0003 |

Results change dramatically, evidence of noise. Permanently remove History of chronic renal failure

Type of Admission has sparse cell, removing as well

Table 4c. Results after table Type of Admission removed

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Comparison/Unit | OR | 95% CI | | P-value |
| Service at ICU admission: | Yes vs No | 0.322 | 0.141 | 0.78 | 0.0114 |
| INF | Yes vs No | 1.034 | 0.429 | 2.491 | 0.9399 |
| CPR Prior to ICU admission | Yes vs No | 4.051 | 0.991 | 16.561 | 0.0515 |
| PO2 from initial blood gases | <=60 vs >60 | 2.178 | 0.624 | 7.605 | 0.2225 |
| PCO | >45 vs <=45 | 0.795 | 0.176 | 3.601 | 0.7661 |
| Creatinine from initial blood gases | >2.0 vs <=2.0 | 2.374 | 0.528 | 10.675 | 0.2597 |
| Systolic blood pressure at ICU admission | >=110 to <150 vs <110 | 0.7 | 0.272 | 1.802 | 0.4597 |
|  | <=150 vs <110 | 0.23 | 0.066 | 0.803 | 0.212 |
| AGE | 10 | 1.725 | 1.274 | 2.336 | 0.0004 |

Remove Creatinine from initial blood gases due to sparse cells

Table 4d: Results after Creatinine from initial blood gases removed.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Comparison/Unit | OR | 95% CI | | P-value |
| Service at ICU admission: | Yes vs No | 0.31 | 0.134 | 0.718 | 0.0063 |
| Infection Probable at ICU admission | Yes vs No | 1.099 | 0.462 | 2.61 | 0.8312 |
| CPR Prior to ICU admission | Yes vs No | 4.361 | 1.082 | 17.579 | 0.0384 |
| PO2 from initial blood gases | <=60 vs >60 | 2.265 | 0.658 | 7.794 | 0.1948 |
| PCO | >45 vs <=45 | 0.664 | 0.151 | 2.918 | 0.5875 |
| Systolic blood pressure at ICU admission | >=110 to <150 vs <110 | 0.618 | 0.248 | 1541 | 0.3023 |
|  | <=150 vs <110 | 0.238 | 0.07 | 0.807 | 0.0212 |
| AGE | 10 | 1.729 | 1.279 | 2.337 | 0.0004 |

Remove variables 1 by 1

Table 4e: results with Infection Probable at ICU admission removed

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Comparison/Unit | OR | 95% CI | | P-value |
| Service at ICU admission: | Yes vs No | 0.306 | 0.133 | 0.705 | 0.0054 |
| CPR Prior to ICU admission | Yes vs No | 4.554 | 1.196 | 17.341 | 0.0263 |
| PO2 from initial blood gases | <=60 vs >60 | 2.326 | 0.694 | 7.799 | 0.1714 |
| PCO | >45 vs <=45 | 0.67 | 0.153 | 2.925 | 0.5339 |
| Systolic blood pressure at ICU admission | >=110 to <150 vs <110 | 0.624 | 0.252 | 1.5484 | 0.3095 |
|  | <=150 vs <110 | 0.236 | 0.07 | 0.795 | 0.0198 |
| AGE | 10 | 1.742 | 1.298 | 2.338 | 0.0002 |

Results remain relatively unchanged. No evidence of confounding

Table 4f: results without PCO

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Comparison/Unit | OR | 95% CI | | P-value |
| Service at ICU admission: | Yes vs No | 0.304 | 0.132 | 0.701 | 0.0052 |
| CPR Prior to ICU admission | Yes vs No | 4.293 | 1.142 | 16.137 | 0.031 |
| PO2 from initial blood gases | <=60 vs >60 | 2.022 | 0.679 | 6.021 | 0.2061 |
| Systolic blood pressure at ICU admission | >=110 to <150 vs <110 | 0.661 | 0.272 | 1.603 | 0.3591 |
|  | <=150 vs <110 | 0.244 | 0.073 | 0.814 | 0.0218 |
| AGE | 10 | 1.727 | 1.291 | 2.31 | 0.0002 |

Results stay relatively same. No evidence of confounding. Variable removed

Table 4e: results without Systolic blood pressure at ICU admission

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Comparison/Unit | OR | 95% CI | | P-value |
| Service at ICU admission: | Yes vs No | 0.28 | 0.28 | 0.124 | 0.0022 |
| CPR Prior to ICU admission | Yes vs No | 4.847 | 4.847 | 1.284 | 0.0199 |
| PO2 from initial blood gases | <=60 vs >60 | 2.333 | 2.333 | 0.835 | 0.1062 |
| AGE | 10 | 1.759 | 1.759 | 1.307 | 0.0002 |

All result significant. Need to transform Systolic blood pressure at ICU admission and include interactions

Table 5: Results for variables with univariate p-values≥0.25 when added, one at a time, to the model in Table 4e

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Comparison/Unit | OR | 95%CI | | P-Value |
| Gender | Female vs Male | 1.383 | 0.604 | 3.165 | 0.4425 |
| RACE | Black vs Wite | 1.042 | 0.112 | 9.704 | 0.9712 |
|  | Other vs White | 1.277 | 0.131 | 12.421 | 0.833 |
| Cancer part of the present problem | YES vs NO | 4.463 | 1.232 | 16.1777 | 0.0228 |
| Previous admision to an ICU within 6 months | Yes vs No | 1.796 | 0.583 | 5.53 | 0.3076 |
| Long bone, multiple, neck, single area, or hip fracture | YES vs NO | 6.732 | 1.265 | 35.841 | 0.0254 |
| PO2 from initial blood gases | <7.25 vs >=7.25 | 0.803 | 0.175 | 3.694 | 0.7784 |
| Bicarbonate from initial blood gases | <18 vs >=18 | 0.489 | 0.111 | 2.163 | 0.3457 |
| Heart Rate at ICU admission | 40 | 0.651 | 0.351 | 1.206 | 0.1725 |

Cancer part of the present problem & Long bone, multiple, neck, single area, or hip fracture statistically significant at the 0.05 level. Both variables have wide confidence intervals and evidence of sparse cells.

Table 6: Possible transformations in multivariate model.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Transformation** | **Deviance** | **Comparison** | **P-Value** |
| **Systolic blood pressure at ICU admission** | Linear | 164.691 | Best 1-power vs linear | 0.1878 |
|  | Best 1-power 1/sqrt(SYS) | 162.956 | Best 2-power vs Linear | 0.2790 |
|  | Best 2 Power SYS at ICU admission^3\*SYS at ICU admission^3ln(SYS) | 160.849 | Bets 2-power vs Best 1-power | 0.3486 |
|  |  |  |  |  |
| **AGE** | Linear | 164.691 | Best 1-power vs linear | 0.4886 |
|  | Best 1-power (AGE^2) | 164.212 | Best 2-power vs Linear | 0.9114 |
|  | Best 2 Power AGE^3\*sqrt(AGE) | 164.157 | Bets 2-power vs Best 1-power | 0.9732 |

No transformations suggested

Table 7a: Interaction of significance values of variables in table 4e

|  |  |
| --- | --- |
| Interaction | P-value |
| Service at ICU admission:\*CPR Prior to ICU admission | 0.9899 |
| Service at ICU admission:\*PO2 from initial blood gases | 0.9748 |
| Service at ICU admission:\*Age | 0.3198 |
| Service at ICU admission:\*Cancer part of the present problem | 0.9643 |
|  |  |
| CPR Prior to ICU admission\*PO2 from initial blood gases | NULL |
| CPR Prior to ICU admission\*AGE | 0.286 |
| CPR Prior to ICU admission\*Cancer part of the present problem | NULL |
|  |  |
| PO2 from initial blood gases\*AGE | 0.5045 |

No significant interactions

Due to insufficient results, removing CPR Prior to ICU admission

Table 7b: Interaction results with removal of CPR Prior to ICU admission

|  |  |
| --- | --- |
| Interaction | P-value |
| Service at ICU admission:\*PO2 from initial blood gases | 0.9745 |
| Service at ICU admission:\*Age | 0.1801 |
| Service at ICU admission:\*Cancer part of the present problem | 0.9649 |
|  |  |
|  |  |
| PO2 from initial blood gases\*AGE | 0.3939 |
| PO2 from initial blood gases\*Cancer part of the present problem | 0.9877 |
|  |  |
| AGE\*Cancer part of the present problem | 0.3893 |

No significant interactions.

Table 7c: Checking interactions with Infection probably at ICU admission for interest

|  |  |
| --- | --- |
| Interaction | P-value |
| Service at ICU admission:\*Infection Probable at ICU admission | 0.991 |
| PO2 from initial blood gases\*Infection Probable at ICU admission | 0.8833 |
| AGE\*Infection Probable at ICU admission | 0.7971 |
| Cancer part of the present problem\*Infection Probable at ICU admission | 0.1886 |

No significant interactions

Table 10: Final Model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Coefficient | Standard Error | Wald Chi-Square | P-Value |
| Intercept | -4.4712 | 1.0104 | 19.5839 | <0.0001 |
| Service at ICU admission: | -1.7275 | 0.4272 | 16.3527 | <0.0001 |
| PO2 from initial blood gases | 0.5553 | 0.5298 | 1.0988 | 0.2945 |
| AGE | 0.0602 | 0.0151 | 15.8519 | <0.0001 |
| Cancer part of the present problem | 1.3949 | 0.6532 | 4.5607 | 0.0327 |

Table 11: Odds Ratios for final Model

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Comparison/Unit | OR | 95%CI | | P-Value |
| Service at ICU admission: | Surgical vs Medical | 0.178 | 0.077 | 0.411 | <0.0001 |
| PO2 from initial blood gases | <=60 vs >60 | 1.742 | 0.617 | 4.922 | 0.2945 |
| AGE | 10 | 1.825 | 1.357 | 2.454 | <0.0001 |
| Cancer part of the present problem | Yes vs No | 4.035 | 1.122 | 14.514 | 0.0327 |

Model seems relatively stable. Cancer as part of the present problem CI’s relatively wide, but an important variable nonetheless.

Interpretations:

Service at ICU admission

* If you are in a surgical setting you are 0.17 times as likely to experience death. In other words, you are 83% less likely to experience death in a surgical setting.

AGE

* A 10 year increase in age significantly increases the chance of experiencing death. You are 1.83 times as likely to experience death for every 10 years.

Cancer as part of the present problem

* Having Cancer as part of the present means you are 4 times as likely to experience death.
* Note: 95% CI’s are relatively wide.

SAS Code

libname sdat 'C:\Users\ndyet\_000\Desktop\Class Folders\Spring 2016\ERHS 642\Data';

**data** ICU\_altered; set sdat.ICU\_altered;

if race=**1** then do; r1=**0**; r2=**0**; end;

else if race=**2** then do; r1=**1**; r2=**0**; end;

else if race=**3** then do; r1=**0**; r2=**1**; end;

if **16**<= SYS <**110** then SYSa=**0**;

else if **110**<= SYS <**150** then SYSa=**1**;

else if SYS >= **150** then SYSa=**2**;

**run**;

**proc** **print** data=ICU\_altered;

**run**;

**proc** **sort** data=ICU\_altered; by STA; **run**;

**proc** **freq** data=ICU\_altered; tables (GENDER RACE SER CAN CRN INF CPR PRE TYP FRA PO2 PH PCO BIC CRE LOC)\*STA/norow nopercent;

**run**;

**proc** **univariate** data=ICU\_altered; by sta;

var age SYS HRA;

**run**;

**proc** **freq** data=ICU\_altered; tables STA; **run**;

\* Spline effect plots \*;

**proc** **univariate** data=ICU\_altered; var age SYS HRA; **run**;

**proc** **logistic** descending data=ICU\_altered;

effect ages=spline(age/knotmethod=list(**48.5** **65** **72**) basis=tpf(noint) degree=**1**);

model STA=ages; effectplot;

**run**;

**proc** **logistic** descending data=ICU\_altered;

effect SYSs=spline(SYS/knotmethod=list(**110** **130** **148**) basis=tpf(noint) degree=**1**);

model STA=SYSs; effectplot;

**run**;

**proc** **logistic** descending data=ICU\_altered;

effect HRAs=spline(HRA/knotmethod=list(**80** **94** **121**) basis=tpf(noint) degree=**1**);

model STA=HRAs; effectplot;

**run**;

\* Univariate models \*;

**proc** **logistic** descending data=ICU\_altered; class GENDER/param=ref ref=first; model STA=GENDER; **run**;

**proc** **logistic** descending data=ICU\_altered; class RACE/param=ref ref=first; model STA=RACE; **run**;

**proc** **logistic** descending data=ICU\_altered; class SER/param=ref ref=first; model STA=SER; **run**;

**proc** **logistic** descending data=ICU\_altered; class CAN/param=ref ref=first; model STA=CAN; **run**;

**proc** **logistic** descending data=ICU\_altered; class CRN/param=ref ref=first; model STA=CRN; **run**;

**proc** **logistic** descending data=ICU\_altered; class INF/param=ref ref=first; model STA=INF; **run**;

**proc** **logistic** descending data=ICU\_altered; class CPR/param=ref ref=first; model STA=CPR; **run**;

**proc** **logistic** descending data=ICU\_altered; class PRE/param=ref ref=first; model STA=PRE; **run**;

**proc** **logistic** descending data=ICU\_altered; class TYP/param=ref ref=first; model STA=TYP; **run**;

**proc** **logistic** descending data=ICU\_altered; class FRA/param=ref ref=first; model STA=FRA; **run**;

**proc** **logistic** descending data=ICU\_altered; class PO2/param=ref ref=first; model STA=PO2; **run**;

**proc** **logistic** descending data=ICU\_altered; class PH/param=ref ref=first; model STA=PH; **run**;

**proc** **logistic** descending data=ICU\_altered; class PCO/param=ref ref=first; model STA=PCO; **run**;

**proc** **logistic** descending data=ICU\_altered; class BIC/param=ref ref=first; model STA=BIC; **run**;

**proc** **logistic** descending data=ICU\_altered; class CRE/param=ref ref=first; model STA=CRE; **run**;

**proc** **logistic** descending data=ICU\_altered; class LOC/param=ref ref=first; model STA=LOC; **run**;

**proc** **logistic** descending data=ICU\_altered; class SYSa/param=ref ref=first; model STA=SYSa; **run**;

**proc** **logistic** descending data=ICU\_altered; model STA=age/clodds=wald; units age=**10**; **run**;

**proc** **logistic** descending data=ICU\_altered; model STA=SYS/clodds=wald; units SYS=**40**; **run**;

**proc** **logistic** descending data=ICU\_altered; model STA=HRA/clodds=wald; units HRA=**40**; **run**;

\* Multivariate models \*;

**proc** **logistic** descending data=ICU\_altered;

class SER CRN INF CPR TYP PO2 PCO CRE SYSa/param=ref ref=first;

model STA=SER CRN INF CPR TYP PO2 PCO CRE SYSa age/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER INF CPR TYP PO2 PCO CRE SYSa/param=ref ref=first;

model STA=SER INF CPR TYP PO2 PCO CRE SYSa age/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER INF CPR PO2 PCO CRE SYSa/param=ref ref=first;

model STA=SER INF CPR PO2 PCO CRE SYSa age/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER INF CPR PO2 PCO SYSa/param=ref ref=first;

model STA=SER INF CPR PO2 PCO SYSa age/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 PCO SYSa/param=ref ref=first;

model STA=SER CPR PO2 PCO SYSa age/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 SYSa/param=ref ref=first;

model STA=SER CPR PO2 SYSa age/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2/param=ref ref=first;

model STA=SER CPR PO2 age/clodds=wald;

units age=**10**;

**run**;

\*Add >=.25 variables one at a time one at a ttime;

**proc** **logistic** descending data=ICU\_altered;

class GENDER SER CPR PO2/param=ref ref=first;

model STA=SER CPR PO2 age GENDER/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 RACE/param=ref ref=first;

model STA=SER CPR PO2 age RACE/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 CAN/param=ref ref=first;

model STA=SER CPR PO2 age CAN/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 PRE/param=ref ref=first;

model STA=SER CPR PO2 age PRE/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 FRA/param=ref ref=first;

model STA=SER CPR PO2 age FRA/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 PH/param=ref ref=first;

model STA=SER CPR PO2 age PH/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 BIC/param=ref ref=first;

model STA=SER CPR PO2 age BIC/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2/param=ref ref=first;

model STA=SER CPR PO2 age HRA/clodds=wald;

units age=**10** HRA=**40**;

**run**;

\*Final Model BEFORE Trans/interactions;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2/param=ref ref=first;

model STA=SER CPR PO2 age/clodds=wald;

units age=**10**;

**run**;

\* Multivariate scale assessment, height \*;

\*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\*;

\* \*;

\* FP METHOD \*;

\*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\*;

\*\* Macro for fp assessment \*\*;

**%macro** fp1(dset,y,var,lb,p1);

%do %until(&p1=**7**);

%put \*\*\*\*\* &p1 \*\*\*\*\*;

ODS output FitStatistics = mfs;

data fpdat; set &dset; if &var>&lb; pc=&p1/**2**;

if pc ne **0** then F1=&var\*\*pc; else if pc = **0** then F1=log(&var);

run;

proc logistic descending data=fpdat;

model &y=F1 SER CPR PO2 AGE; \*-------------------F1 represents the variable being tested for scale (SYS);

run;

data mfs; set mfs; if criterion='-2 Log L'; drop Criterion InterceptOnly; run;

proc append data=mfs base=tres; run;

proc datasets; delete fpdat mfs; run;

quit;

%let p1=%eval(&p1+1);

%end;

**%mend** fp1;

%***fp1***(ICU\_altered,STA,SYS,**0**,-**4**); \*-----------Enter data set name, outcome variable name and name of variable being tested for scale;

**data** pvals; do p1=-**4** to **6**; output; end; **run**;

**data** pvals; set pvals; p1=p1/**2**; **run**;

**data** tres; merge pvals tres; if p1 in (-**1.5**, **1.5**, **2.5**) then delete; **run**;

**proc** **sort** data=tres; by InterceptAndCovariates; **run**;

**data** tres; set tres; if \_N\_=**1** or p1=**1**; **run**;

**%macro** fp2(dset,y,var,lb,p1,p2);

%do %until(&p1=**7**);

%do %until(&p2=**7**);

%put \*\*\*\*\* &p1 &p2 \*\*\*\*\*;

ODS output FitStatistics = mfs;

data fpdat; set &dset; if &var>&lb; pc1=&p1/**2**; pc2=&p2/**2**;

if pc1 ne **0** then F1=&var\*\*pc1; else if pc1 = **0** then F1=log(&var);

if pc1 ne pc2 then do; if pc2 ne **0** then F2=&var\*\*pc2;

else if pc2 = **0** then F2=log(&var); end;

if pc1=pc2 then F2=F1\*log(&var);

run;

proc logistic descending data=fpdat;

model &y=F1 F2 SER CPR PO2 AGE; \*------------F1 and F2 represent the variable being tested for scale (height);

run;

data mfs; set mfs; if criterion='-2 Log L'; drop Criterion InterceptOnly; run;

proc append data=mfs base=tres2; run;

proc datasets; delete fpdat mfs; run;

quit;

%let p2=%eval(&p2+1);

%end;

%let p2=%eval(-4);

%let p1=%eval(&p1+1);

%end;

**%mend** fp2;

%***fp2***(ICU\_altered,STA,SYS,**0**,-**4**,-**4**); \*-----------Enter data set name, outcome variable name and name of variable being tested for scale;

**data** pvals2; do p1=-**4** to **6**; do p2=-**4** to **6**; output;end; end; **run**;

**data** pvals2; set pvals2; p1=p1/**2**; p2=p2/**2**; **run**;

**data** tres2; merge pvals2 tres2;

if p1 in (-**1.5**, **1.5**, **2.5**) or p2 in (-**1.5**, **1.5**, **2.5**) then delete; **run**;

**proc** **sort** data=tres2; by InterceptAndCovariates; **run**;

**data** tres2; set tres2; if \_N\_=**1**; **run**;

**data** comb; set tres tres2; **run**;

**data** c1; set comb; if p1=**1** and p2=**.**; rename InterceptAndCovariates=Dev\_linear;

drop p1 p2; **run**;

**data** c2; set comb; if p1 ne **1** and p2=**.**; rename InterceptAndCovariates=Dev\_fp1;

rename p1=e\_fp1; drop p2; **run**;

**data** c3; set comb; if p2 ne **.**; rename InterceptAndCovariates=Dev\_fp2;

rename p1=e1\_fp2; rename p2=e2\_fp2; **run**;

**data** c;

merge c1 c2 c3;

diff\_lin\_fp1=Dev\_linear-Dev\_fp1;

diff\_lin\_fp2=Dev\_linear-Dev\_fp2;

diff\_fp1\_fp2=Dev\_fp1-Dev\_fp2;

p\_lin\_fp1=**1**-probchi(diff\_lin\_fp1,**1**);

p\_lin\_fp2=**1**-probchi(diff\_lin\_fp2,**3**);

p\_fp1\_fp2=**1**-probchi(diff\_fp1\_fp2,**2**);

**run**;

**proc** **print** noobs data=c;

var Dev\_linear e\_fp1 Dev\_fp1 e1\_fp2 e2\_fp2 Dev\_fp2 p\_lin\_fp1 p\_lin\_fp2 p\_fp1\_fp2;

format p\_lin\_fp1 p\_lin\_fp2 p\_fp1\_fp2 **6.4**;

**run**;

**proc** **datasets**; delete tres tres2 pvals pvals2 comb c c1 c2 c3; **run**; **quit**;

\* End macro for fp assessment \*;

\*\* Macro for fp assessment For AGE \*\*;

**%macro** fp1(dset,y,var,lb,p1);

%do %until(&p1=**7**);

%put \*\*\*\*\* &p1 \*\*\*\*\*;

ODS output FitStatistics = mfs;

data fpdat; set &dset; if &var>&lb; pc=&p1/**2**;

if pc ne **0** then F1=&var\*\*pc; else if pc = **0** then F1=log(&var);

run;

proc logistic descending data=fpdat;

model &y=F1 SER CPR PO2 SYS; \*-------------------F1 represents the variable being tested for scale (SYS);

run;

data mfs; set mfs; if criterion='-2 Log L'; drop Criterion InterceptOnly; run;

proc append data=mfs base=tres; run;

proc datasets; delete fpdat mfs; run;

quit;

%let p1=%eval(&p1+1);

%end;

**%mend** fp1;

%***fp1***(ICU\_altered,STA,AGE,**0**,-**4**); \*-----------Enter data set name, outcome variable name and name of variable being tested for scale;

**data** pvals; do p1=-**4** to **6**; output; end; **run**;

**data** pvals; set pvals; p1=p1/**2**; **run**;

**data** tres; merge pvals tres; if p1 in (-**1.5**, **1.5**, **2.5**) then delete; **run**;

**proc** **sort** data=tres; by InterceptAndCovariates; **run**;

**data** tres; set tres; if \_N\_=**1** or p1=**1**; **run**;

**%macro** fp2(dset,y,var,lb,p1,p2);

%do %until(&p1=**7**);

%do %until(&p2=**7**);

%put \*\*\*\*\* &p1 &p2 \*\*\*\*\*;

ODS output FitStatistics = mfs;

data fpdat; set &dset; if &var>&lb; pc1=&p1/**2**; pc2=&p2/**2**;

if pc1 ne **0** then F1=&var\*\*pc1; else if pc1 = **0** then F1=log(&var);

if pc1 ne pc2 then do; if pc2 ne **0** then F2=&var\*\*pc2;

else if pc2 = **0** then F2=log(&var); end;

if pc1=pc2 then F2=F1\*log(&var);

run;

proc logistic descending data=fpdat;

model &y=F1 F2 SER CPR PO2 SYS; \*------------F1 and F2 represent the variable being tested for scale (height);

run;

data mfs; set mfs; if criterion='-2 Log L'; drop Criterion InterceptOnly; run;

proc append data=mfs base=tres2; run;

proc datasets; delete fpdat mfs; run;

quit;

%let p2=%eval(&p2+1);

%end;

%let p2=%eval(-4);

%let p1=%eval(&p1+1);

%end;

**%mend** fp2;

%***fp2***(ICU\_altered,STA,AGE,**0**,-**4**,-**4**); \*-----------Enter data set name, outcome variable name and name of variable being tested for scale;

**data** pvals2; do p1=-**4** to **6**; do p2=-**4** to **6**; output;end; end; **run**;

**data** pvals2; set pvals2; p1=p1/**2**; p2=p2/**2**; **run**;

**data** tres2; merge pvals2 tres2;

if p1 in (-**1.5**, **1.5**, **2.5**) or p2 in (-**1.5**, **1.5**, **2.5**) then delete; **run**;

**proc** **sort** data=tres2; by InterceptAndCovariates; **run**;

**data** tres2; set tres2; if \_N\_=**1**; **run**;

**data** comb; set tres tres2; **run**;

**data** c1; set comb; if p1=**1** and p2=**.**; rename InterceptAndCovariates=Dev\_linear;

drop p1 p2; **run**;

**data** c2; set comb; if p1 ne **1** and p2=**.**; rename InterceptAndCovariates=Dev\_fp1;

rename p1=e\_fp1; drop p2; **run**;

**data** c3; set comb; if p2 ne **.**; rename InterceptAndCovariates=Dev\_fp2;

rename p1=e1\_fp2; rename p2=e2\_fp2; **run**;

**data** c;

merge c1 c2 c3;

diff\_lin\_fp1=Dev\_linear-Dev\_fp1;

diff\_lin\_fp2=Dev\_linear-Dev\_fp2;

diff\_fp1\_fp2=Dev\_fp1-Dev\_fp2;

p\_lin\_fp1=**1**-probchi(diff\_lin\_fp1,**1**);

p\_lin\_fp2=**1**-probchi(diff\_lin\_fp2,**3**);

p\_fp1\_fp2=**1**-probchi(diff\_fp1\_fp2,**2**);

**run**;

**proc** **print** noobs data=c;

var Dev\_linear e\_fp1 Dev\_fp1 e1\_fp2 e2\_fp2 Dev\_fp2 p\_lin\_fp1 p\_lin\_fp2 p\_fp1\_fp2;

format p\_lin\_fp1 p\_lin\_fp2 p\_fp1\_fp2 **6.4**;

**run**;

**proc** **datasets**; delete tres tres2 pvals pvals2 comb c c1 c2 c3; **run**; **quit**;

\* End macro for fp assessment \*;

\*Multiplicative Interactions One at a time;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 CAN/param=ref ref=first;

model STA=SER CPR PO2 age CAN SER\*PO2/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 CAN/param=ref ref=first;

model STA=SER CPR PO2 age SER\*AGE/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 CAN/param=ref ref=first;

model STA=SER CPR PO2 age CAN SER\*CAN/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 CAN/param=ref ref=first;

model STA=SER CPR PO2 age CAN PO2\*CAN/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER CPR PO2 CAN/param=ref ref=first;

model STA=SER CPR PO2 age CAN AGE\*CAN/clodds=wald;

units age=**10**;

**run**;

\*Multiplicative Interactions One at a time without CPR;

**proc** **logistic** descending data=ICU\_altered;

class SER PO2 CAN/param=ref ref=first;

model STA=SER PO2 age CAN SER\*PO2/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER PO2 CAN/param=ref ref=first;

model STA=SER PO2 age SER\*AGE/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER PO2 CAN/param=ref ref=first;

model STA=SER PO2 age CAN SER\*CAN/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER PO2 CAN/param=ref ref=first;

model STA=SER PO2 age CAN PO2\*AGE/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER PO2 CAN/param=ref ref=first;

model STA=SER PO2 age CAN PO2\*CAN/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER PO2 CAN/param=ref ref=first;

model STA=SER PO2 age CAN AGE\*CAN/clodds=wald;

units age=**10**;

**run**;

\*Interactions of Interest.

\*Infection

proc logistic descending data=ICU\_altered;

**proc** **logistic** descending data=ICU\_altered;

class SER PO2 CAN INF/param=ref ref=first;

model STA=SER PO2 age CAN INF SER\*INF/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER PO2 CAN INF/param=ref ref=first;

model STA=SER PO2 age CAN INF PO2\*INF/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER PO2 CAN INF/param=ref ref=first;

model STA=SER PO2 age CAN INF AGE\*INF/clodds=wald;

units age=**10**;

**run**;

**proc** **logistic** descending data=ICU\_altered;

class SER PO2 CAN INF/param=ref ref=first;

model STA=SER PO2 age CAN INF CAN\*INF/clodds=wald;

units age=**10**;

**run**;

\*\*\*\*FINAL MODEL\*\*\*\*\*;

**proc** **logistic** descending data=ICU\_altered;

class SER PO2 CAN /param=ref ref=first;

model STA=SER PO2 age CAN/clodds=wald;

units age=**10**;

**run**;