

Role of Smoking and Cholesterol in CVD, CHD, and Stroke in the Framingham Heart Study

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BS 853 – Generalized Linear Models with Applications

Spring 2021

Boston University

## **Introduction**

The Framingham Heart Study is a longitudinal prospective cohort study of the etiology of cardiovascular disease among a population of free-living subjects in the community of Framingham, Massachusetts. Established in 1948, the Framingham Heart Study now has data on three generations of participants.

The purpose of this report is to examine the association between incidence of heart disease with cholesterol levels and smoking using data collected on the Framingham Study population. The dataset contains 4434 unique participants between the ages of 32 and 81, with 1944 men and 2490 women. The data was provided in a longitudinal format for up to 3 follow-up periods and contained information about incidence and time in days to the first cardiovascular disease (CVD), coronary heart disease (CHD), and stroke event.

The Center for Disease Prevention and Control (CDC) states that smoking is a major cause of CVD and contributes to approximately 1 in 4 of deaths from CVD due to smoking’s potential to raise triglycerides, lower good cholesterol (HDL), and increase the buildup of plaque[[1]](#footnote-1). The Framingham data shows that smokers generally have an almost two-fold increased risk of CHD or myocardial infarction[[2]](#footnote-2). Similarly, unhealthy levels of cholesterol can increase the risk for heart disease[[3]](#footnote-3). The risk presents itself around 200 mg/dL, and there doesn’t appear to be a threshold where the risk is not present at all or a threshold where the risk suddenly begins. In addition, risk factors such as age, sex, history of heart disease in the family, obesity, diabetes, an unhealthy diet, and clinical depression can increase the potential for an individual to develop heart disease[[4]](#footnote-4). Levy et al. found evidence to support that age and sex play major roles in the development of coronary heart disease (CHD)[[5]](#footnote-5). Among men between the ages 30 and 62, there is a linear increase in the incidence of coronary heart disease as age increases. Women also have a greater risk for coronary heart disease after menopause, though their risk always remains lower than the risk for men.

As a result of the literature that highlighted the risk of smoking, age, triglycerides, and other factors that can increase the risk of heart disease, incidence and time to CVD, stroke, and CHD were chosen as the outcomes. Quantitative explanatory variables that were provided include age, systolic blood pressure (mmHg), diastolic blood pressure (mmHg), number of cigarettes smoked per day, serum total cholesterol (mg/dL), high-density lipoprotein cholesterol (mg/dL), low-density lipoprotein cholesterol (mg/dL), BMI (kg/m2), serum glucose (mg/dL), and heart rate (beats per minute). Binary yes/no variables include use of antihypertensive medication, whether they were a current smoker, and if they had diabetes (serum glucose of over 200 mg/dL). Lastly, sex was a binary categorical variable.

## **Data**

Descriptive characteristics about the study population as a whole and for each sex are presented in Table 1. Only baseline values from Exam 1 were used. Total cholesterol was divided into four categories (<200 mg/dL, 200-219, 220-259 mg/dL, and 260+ mg/dL) since there was evidence of a nonlinear association between total cholesterol levels and mortality[[6]](#footnote-6). Cigarettes smoked per day were also separated into four categories (0 per day, 1-10 per day, 11-20 per day, and 21+ per day).

The only variables that were evenly distributed between sexes was age, serum glucose, diabetes, and incidence of stroke. For the rest of the predictor and outcome variables, there was a significant difference in the proportion or means between males and females.

**Table 1**: Baseline Characteristics of the Framingham Dataset

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Baseline Characteristics** | | | | |
|  | **Male**  (n=1,944)  43.84% | **Female**  (n=2,490)  56.16% | **Total**  (n=4,434) | **p-value** |
| **Age** (mean, SD) | 49.79 (8.72) | 50.03 (8.64) | 49.93 (8.68) | 0.3450 |
| **Systolic BP** (mean, SD) | 131.74 (19.44) | 133.82 (24.46) | 132.91 (22.42) | 0.0016 |
| **Diastolic BP** (mean, SD) | 83.71 (11.44) | 82.60 (12.50) | 83.08 (12.06) | 0.0020 |
| **Use of BP Meds** (n,%) | | | | |
| No BP Meds | 1,880 (97.81%) | 2,349 (95.84%) | 4,229 (96.71%) | 0.0003 |
| BP Meds | 42 (2.19%) | 102 (4.16%) | 144 (3.29%) |
| **Heart Rate** (mean, SD) | 74.40 (11.90) | 77.06 (12.15) | 75.89 (12.11) | <0.0001 |
| **Total Cholesterol**  (mean, SD) | 233.58 (42.36) | 239.68 (46.22) | 236.98 (44.65) | <0.0001 |
| **Cholesterol Category** (n,%) | | | |  |
| <200 | 392 (20.16%) | 530 (21.29%) | 922 (20.79%) | <0.0001 |
| 200 - 219 | 364 (18.72%) | 369 (14.82%) | 733 (16.53%) |
| 220 - 259 | 710 (36.52%) | 817 (32.81%) | 1,527 (34.44%) |
| 260+ | 478 (24.59%) | 774 (31.08%) | 1,252 (28.24%) |
| **Smoking Status** (n,%) | | | | |
| Not Smokers | 769 (39.56%) | 1,483 (59.60%) | 4,229 (96.71%) | <0.0001 |
| Smokers | 1,175 (60.44%) | 1,006 (40.40%) | 144 (3.29%) |
| **Cigarettes Per Day**  (mean, SD) | 13.23 (13.78) | 5.65 (8.96) | 8.97 (11.93) | <0.0001 |
| **Cigarette Category** (n, %) | | | | |
| 0 Cigarettes | 769 (39.89%) | 1,484 (59.98%) | 2,253 (51.18%) | <0.0001 |
| 1-10 Cigarettes | 195 (10.11%) | 460 (18.59%) | 655 (14.88%) |
| 11-20 Cigarettes | 583 (30.24%) | 433 (17.50%) | 1,016 (23.08%) |
| 21+ Cigarettes | 381 (19.76%) | 97 (3.92%) | 478 (10.86%) |
| **BMI** (mean, SD) | 26.17 (3.41) | 25.59 (4.56) | 25.85 (4.10) | <0.0001 |
| **Serum Glucose**  (mean, SD) | 82.32 (24.72) | 82.07 (24.14) | 82.19 (24.40) | 0.7468 |
| **Diabetes** (n,%) | | | | |
| No Diabetes | 1,885 (96.97%) | 2,428 (97.51%) | 4,313 (97.27%) | 0.2690 |
| Diabetes | 59 (3.03%) | 62 (2.49%) | 121 (2.73%) |
| **Cardiovascular Disease** (n,%) | | | |  |
| No CVD | 1,258 (64.71%) | 2,019 (81.08%) | 3,277 (73.91%) | <0.0001 |
| CVD | 686 (35.29%) | 471 (18.92%) | 1,157 (26.09%) |
| **Coronary Heart Disease** (n,%) | | | | |
| No CHD | 1,234 (63.48%) | 1,960 (78.71%) | 3,194 (72.03%) | <0.0001 |
| CHD | 710 (36.52%) | 530 (21.29%) | 1,240 (27.97%) |
| **Stroke** (n,%) | | | | |
| No Stroke | 1,751 (90.07%) | 2,268 (91.08%) | 4,019 (90.64%) | 0.2508 |
| Stroke | 193 (9.93%) | 222 (8.92%) | 415 (9.36%) |
| **Days to CVD** (mean, SD) | 6,273.70 (3,015.18) | 7242.86 (2,549.01) | 6,817.95 (2,804.32) | <0.0001 |
| **Days to CHD** (mean, SD) | 6,155.88 (3,066.85) | 7064.61 (2,656.32) | 6,666.20 (2,878.82) | <0.0001 |
| **Days to Stroke** (mean, SD) | 7,003.43 (2,509.10) | 7539.78 (2,262.43) | 7,304.63 (2,388.34) | <0.0001 |

## **Methods**

Cox proportional hazard models were used to model survival time to CVD, CHD, and stroke. ZPH tests using Schoenfeld residuals were used to check the proportional hazards assumption. Model fit was determined using the Schwarz Information Criterion (SBC).

Previous investigations using the Framingham Heart Study adjusted for age, sex, total cholesterol, high density lipoprotein, systolic blood pressure, use of antihypertensive medications, smoking status, diabetes, and BMI in their Cox proportional hazards models[[7]](#footnote-7),[[8]](#footnote-8),[[9]](#footnote-9),[[10]](#footnote-10). Levels of low- and high-density lipoprotein were not provided in the first exam, so the other 8 covariates were included. The first step of the model selection process was to determine whether cholesterol and smoking should be coded as continuous or categorical variables. Table 5 in the Appendix shows the SBC values of the varying models for the three outcomes CVD, CHD, and stroke. The model chosen had total cholesterol as a continuous variable and cigarettes smoked as a categorical variable due to the low SBC values. In addition, cigarette category did not violate the proportional hazards assumption, while cigarettes smoked per day did.

The next step was to determine if systolic blood pressure, diabetes, use of antihypertensive medication, diabetes, and BMI all needed to be included in the final model. From the SBC values (Table 6 in the Appendix), dropping any of those variables did not improve model fit. D’Agostino et al. logarithmically transformed their continuous variables[[11]](#footnote-11). In this investigation, logarithmic transformation of the continuous variables (total cholesterol, age, systolic blood pressure, and BMI) did not improve model performance (Table 7 in Appendix). Wilson et al. included an interaction term between total cholesterol and age, so various interaction terms were considered[[12]](#footnote-12). For this dataset, including interaction terms did not improve the model fit (Table 8 in Appendix).

Lastly, the data was stratified by sex and Cox proportion hazards models were run separately for males and females due to earlier findings that most covariates differed significantly between sexes. The 95% hazards ratio confidence intervals for cholesterol and cigarette category overlapped, so the effects were not significantly different for between sexes (Tables 9-14 in Appendix).

The final model chosen adjusted for total cholesterol, cigarette category, sex, age, SBP, blood pressure medications, diabetes, and BMI, without any interaction terms or stratification. The reference coding were 0 cigarettes smoked, female, no blood pressure medications, and no diabetes.

## **Results**

**Table 2**: Cox proportional hazard model regression coefficients for CVD

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Parameter Estimate** | **Hazard Ratio** | **95% Hazard Ratio Confidence Interval** | **zph test p-value** | **p-value** |
| Total Cholesterol | 0.00306 | 1.003 | 1.002-1.004 | 0.0907 | <0.0001 |
| 1-10 Cigarettes | 0.19715 | 1.218 | 1.013-1.465 | 0.0737 | 0.0363 |
| 11-20 Cigarettes | 0.41644 | 1.517 | 1.302-1.766 | 0.8954 | <.0001 |
| 21+ Cigarettes | 0.34842 | 1.417 | 1.159-1.728 | 0.4318 | 0.0007 |
| Sex (Male) | 0.88603 | 2.425 | 2.128-2.765 | 0.1703 | <0.0001 |
| Age | 0.05847 | 1.060 | 1.052-1.069 | 0.0543 | <0.0001 |
| Systolic Blood Pressure | 0.01533 | 1.015 | 1.013-1.018 | 0.5499 | <0.0001 |
| BP Meds | 0.36172 | 1.436 | 1.103-1.868 | 0.1807 | 0.0071 |
| Diabetes | 0.82074 | 2.272 | 1.777-2.906 | 0.0513 | <0.0001 |
| BMI | 0.02754 | 1.028 | 1.013-1.043 | 0.8981 | 0.0003 |

**Table 3**: Cox proportional hazard model regression coefficients for CHD

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Parameter Estimate** | **Hazard Ratio** | **95% Hazard Ratio Confidence Interval** | **zph test p-value** | **p-value** |
| Total Cholesterol | 0.00424 | 1.004 | 1.003-1.005 | 0.9061 | <.0001 |
| 1-10 Cigarettes | 0.07421 | 1.077 | 0.900-1.289 | 0.3348 | 0.4184 |
| 11-20 Cigarettes | 0.20775 | 1.231 | 1.060-1.430 | 0.0772 | 0.0065 |
| 21+ Cigarettes | 0.26895 | 1.309 | 1.081-1.584 | 0.1531 | 0.0058 |
| Sex (Male) | 0.77762 | 2.176 | 1.922-2.464 | 0.1452 | <0.0001 |
| Age | 0.04513 | 1.046 | 1.038-1.054 | <0.0001 | <0.0001 |
| Systolic Blood Pressure | 0.01177 | 1.012 | 1.009-1.015 | 0.4850 | <0.0001 |
| BP Meds | 0.35662 | 1.428 | 1.105-1.846 | 0.4430 | 0.0065 |
| Diabetes | 0.64325 | 1.903 | 1.469-2.464 | 0.0547 | <0.0001 |
| BMI | 0.03603 | 1.037 | 1.022-1.052 | 0.7864 | <0.0001 |

**Table 4**: Cox proportional hazard model regression coefficients for stroke

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Parameter Estimate** | **Hazard Ratio** | **95% Hazard Ratio Confidence Interval** | **zph test p-value** | **p-value** |
| Total Cholesterol | -0.00213 | 0.998 | 0.996-1.000 | 0.5234 | 0.0764 |
| 1-10 Cigarettes | 0.21597 | 1.241 | 0.915-1.683 | 0.2316 | 0.1646 |
| 11-20 Cigarettes | 0.62455 | 1.867 | 1.456-2.396 | 0.7705 | <0.0001 |
| 21+ Cigarettes | 0.19017 | 1.209 | 0.812-1.800 | 0.5039 | 0.3489 |
| Sex (Male) | 0.37031 | 1.448 | 1.166-1.799 | 0.5493 | 0.0008 |
| Age | 0.08563 | 1.089 | 1.075-1.104 | 0.0202 | <0.0001 |
| Systolic Blood Pressure | 0.01889 | 1.019 | 1.015-1.024 | 0.0870 | <0.0001 |
| BP Meds | 0.72410 | 2.063 | 1.448-2.938 | 0.3536 | <0.0001 |
| Diabetes | 0.88064 | 2.412 | 1.629-3.572 | 0.5560 | <0.0001 |
| BMI | 0.01663 | 1.017 | 0.993-1.041 | 0.3227 | 0.1626 |

**CVD**

Schoenfeld residuals showed the proportional hazards assumption was met for all variables (plots in SAS output). All covariates were significantly associated with time to CVD.

The hazard ratio for total cholesterol was 1.003 (95% confidence interval: 1.002, 1.004), meaning that for each 1 unit increase in mg/dL of total cholesterol, the hazard for CVD increased 1.003 times.

Subjects who smoked 1-10 cigarettes a day had 1.218 (95% confidence interval: 1.013-1.465) times the hazard of CVD compared to those who did not smoke. Subjects who smoked 11-20 cigarettes a day had 1.517 (95% confidence interval: 1.302-1.766) times the hazard of CVD compared to those who did not smoke. Subjects who smoked 21+ cigarettes a day had 1.417 (95% confidence interval: 1.159-1.728) times the hazard of CVD compared to those who did not smoke.

The hazard ratio for age was 1.060 (95% confidence interval: 1.013-1.018), meaning for each additional year older a subject was, their hazard for CVD increased by 1.060. The hazard ratio for SBP was 1.015 (95% confidence interval: 1.013-1.018), meaning for each 1 unit increase in mmHg of SBP, the hazard for CVD increased 1.015 times. The hazard ratio for BMI was 1.028 (95% confidence interval: 1.013-1.043), meaning for each 1 unit increase in kg/m2, the hazard for CVD increased 1.028 times.

Males had 2.425 (95% confidence interval: 2.128-2.765) times the hazard of CVD compared to females. Patients who took antihypertensive medication had 1.436 (95% confidence interval: 1.103-1.868) times the hazard of CVD compared to those who did not take blood pressure medication. Subjects with diabetes had 2.272 (95% confidence interval: 1.777-2.906) times the hazard of CVD compared to those without diabetes.

**CHD**

Schoenfeld residuals showed the proportional hazards assumption was met for all variables except age (plots in SAS Output). All covariates were significantly associated with time to CHD, except for 1-10 cigarettes smoked per day.

The hazard ratio for total cholesterol was 1.004 (95% confidence interval: 1.003, 1.005), meaning that for each 1 unit increase in mg/dL of total cholesterol, the hazard for CHD increased 1.004 times.

Subjects who smoked 1-10 cigarettes a day had 1.077 (95% confidence interval: 0.900-1.289) times the hazard of CHD compared to those who did not smoke, but this effect was not significant. Subjects who smoked 11-20 cigarettes a day had 1.231 (95% confidence interval: 1.060-1.430) times the hazard of CHD compared to those who did not smoke. Subjects who smoked 21+ cigarettes a day had 1.309 (95% confidence interval: 1.081-1.584) times the hazard of CHD compared to those who did not smoke.

The hazard ratio for age was 1.046 (95% confidence interval: 1.038-1.054), meaning for each additional year older a subject was, their hazard for CHD increased by 1.046. The hazard ratio for SBP was 1.012 (95% confidence interval: 1.009-1.015), meaning for each 1 unit increase in mmHg of SBP, the hazard for CHD increased 1.012 times. The hazard ratio for BMI was 1.037 (95% confidence interval: 1.022-1.052), meaning for each 1 unit increase in kg/m2, the hazard for CHD increased 1.037 times.

Males had 2.176 (95% confidence interval: 1.922-2.464) times the hazard of CHD compared to females. Patients who took antihypertensive medication had 1.428 (95% confidence interval: 1.105-1.846) times the hazard of CHD compared to those who did not take blood pressure medication. Patients with diabetes had 1.903 (95% confidence interval: 1.469-2.459) times the hazard of CHD compared to those without diabetes.

**Stroke**

Schoenfeld residuals showed the proportional hazards assumption was met for all variables except age (plots in SAS Output). All covariates were significantly associated with time to stroke, except for total cholesterol, 1-10 cigarettes smoked per day, 21+ cigarettes smoked per day, and BMI.

The hazard ratio for total cholesterol was 0.998 (95% confidence interval: 0.996, 1.000), meaning that for each 1 unit increase in mg/dL of total cholesterol, the hazard for stroke decreased by a factor of 0.998. However, this effect was not significant.

Subjects who smoked 1-10 cigarettes a day had 1.241 (95% confidence interval: 0.915-1.683) times the hazard of stroke compared to those who did not smoke, but this effect was not significant. Subjects who smoked 11-20 cigarettes a day had 1.867 (95% confidence interval: 1.456-2.396) times the hazard of stroke compared to those who did not smoke. Subjects who smoked 21+ cigarettes a day had 1.209 (95% confidence interval: 0.812-1.800) times the hazard of CHD compared to those who did not smoke, but this effect was not significant.

The hazard ratio for age was 1.089 (95% confidence interval: 1.075-1.104), meaning for each additional year older a subject was, their hazard for stroke increased by 1.089. The hazard ratio for SBP was 1.019 (95% confidence interval: 1.015-1.024), meaning for each 1 unit increase in mmHg of SBP, the hazard for stroke increased 1.019 times. The hazard ratio for BMI was 1.017 (95% confidence interval: 0.993-1.041), meaning for each 1 unit increase in kg/m2, the hazard for stroke increased 1.017 times. However, this effect was not significant.

Males had 1.448 (95% confidence interval: 1.166-1.799) times the hazard of stroke compared to females. Patients who took antihypertensive medication had 2.063 (95% confidence interval: 1.448-2.938) times the hazard of stroke compared to those who did not take blood pressure medication. Patients with diabetes had 2.412 (95% confidence interval: 1.629-3.572) times the hazard of stroke compared to those without diabetes.

## **Discussion**

The unavailability of LDL and HDL levels for early periods may decrease the accuracy of the models, as Leo et al. found significant associations of LDL and HDL with heart disease[[13]](#footnote-13). The proportional hazards assumption was violated for age in the CHD and stroke model. However, since the sample size was large (4273 observations), and age wasn’t the explanatory variable of interest, the violation most likely did not make a large difference in the parameter estimates.

Pearson and Spearman correlation coefficients were calculated between the included covariates to identify any collinearity issues (correlation chart in SAS output). The largest correlations were between SBP and age (Pearson coefficient = 0.39849, Spearman coefficient = 0.39597) and SBP and BMI (Pearson coefficient = 0.32809, Spearman coefficient = 0.32403). Those correlation coefficients were below 0.4, so any linear relationships between the variables would be considered very weak.

Box and whiskers plots were examined to identify outliers in continuous variables. There were no outliers for age. For total cholesterol, 115 observations were considered outliers, having values of 331 mg/dL or more. For systolic blood pressure, values greater than 183.75 mmHg were considered outliers. Only 150 observations exceeded that threshold, which is a minor portion of the whole dataset. For BMI, there was only 1 observation below the lower outlier threshold of 15.59 kg/m2, and 103 observations exceeding the upper limit of 35.59 kg/m2. Compared to the large sample size of 4434, those couple hundred outliers would not affect the distribution of the dataset in any noticeable way (plots in SAS output).

## **Conclusion**

Time to CVD was significantly associated with total cholesterol and smoking category. For each 1 unit increase in mg/dL of total cholesterol, the hazard for CVD increased 1.003 times (95% confidence interval: 1.002, 1.004). Subjects who smoked 1-10 cigarettes a day had 1.218 (95% confidence interval: 1.013-1.465) times the hazard of CVD compared to those who did not smoke. Subjects who smoked 11-20 cigarettes a day had 1.517 (95% confidence interval: 1.302-1.766) times the hazard of CVD compared to those who did not smoke. Subjects who smoked 21+ cigarettes a day had 1.417 (95% confidence interval: 1.159-1.728) times the hazard of CVD compared to those who did not smoke. The hazard ratio for 21+ cigarettes was lower than the hazard ratio for 11-20 cigarettes. The confidence intervals for 11-20 cigarettes and 21+ cigarettes overlapped, which indicates that there is no significant difference for hazard of CVD between those who smoke 11-20 and 21+ cigarettes a day.

Time to CHD was significantly associated with total cholesterol and smoking category. For each 1 unit increase in mg/dL of total cholesterol, the hazard for CVD increased 1.004 times (95% confidence interval: 1.003, 1.005). Subjects who smoked 11-20 cigarettes a day had 1.231 (95% confidence interval: 1.060-1.430) times the hazard of CHD compared to those who did not smoke. Subjects who smoked 21+ cigarettes a day had 1.309 (95% confidence interval: 1.081-1.584) times the hazard of CHD compared to those who did not smoke. The confidence intervals for 11-20 cigarettes and 21+ cigarettes overlapped, which indicates that there is no significant difference for hazard of CHD between those who smoke 11-20 and 21+ cigarettes a day.

Lastly, time to stroke was significantly associated with smoking 11-20 cigarettes a day. Subjects who smoked 11-20 cigarettes a day had 1.870 (95% confidence interval: 1.458-2.398) times the hazard of CHD compared to those who did not smoke. In this population, incidence and time to stroke was not explained by the predictors of interest, total cholesterol and smoking.

CVD, CHD, and stroke were all significantly associated with sex, age, systolic blood pressure, use of antihypertensive medications, and diabetes. Males had more than twice the hazard for CVD and CHD than females, and an almost 50% increase in hazard for stroke than females. The hazard ratio for all three outcomes increased each year of age and mmHg of systolic blood pressure. Subjects taking blood pressure medications had an almost 50% increase in hazard for CVD and CHD, and more than twice the hazard for stroke. Diabetics had more than twice the hazard for CVD and stroke than non-diabetes, while almost twice the hazard for CHD than non-diabetes.

## 

## **Appendix**

**Table 5**. SBC values for Cox proportional hazards models testing cholesterol category, total serum cholesterol, smoking status, cigarettes per day, and cigarette category

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **Covariates** | **SBC Values** | | |
| **CVD** | **CHD** | **Stroke** |
| A1 | Cholesterol Category, Smoking Status,  Sex, Age, SBP, BP\_Meds, Diabetes, BMI | 17614.792 | 19070.508 | 6240.337 |
| A2 | Total Cholesterol, Smoking Status,  Sex, Age, SBP, BP\_Meds, Diabetes, BMI | 17395.850 | 18798.445 | 6171.734 |
| A3 | Cholesterol Category, Cigarettes,  Sex, Age, SBP, BP\_Meds, Diabetes, BMI | 17438.741 | 18884.722 | 6198.189 |
| A4 | Total Cholesterol, Cigarettes,  Sex, Age, SBP, BP\_Meds, Diabetes, BMI | 17218.240 | 18611.223 | 6129.658 |
| A5 | Cholesterol Category, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI | 17432.678 | 18883.124 | 6196.626 |
| A6 | Total Cholesterol, Cigarette Category,  Sex, Age, SBP, BP\_Meds, Diabetes, BMI | 17221.371 | 18623.770 | 6129.222 |

**Table 6**. SBC values for Cox proportional hazards models testing combinations of covariates SBP, blood pressure medication taken, diabetes, and BMI

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **Covariates** | **SBC Values** | | |
| **CVD** | **CHD** | **Stroke** |
| B1 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, Diabetes, BMI | 17561.616 | 19022.870 | 6239.411 |
| B2 | Total Cholesterol, Cigarette Category, Sex, Age, BP\_Meds, Diabetes, BMI | 17323.587 | 18683.627 | 6189.006 |
| B3 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, BMI | 17248.935 | 18636.664 | 6138.645 |
| B4 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes | 17323.721 | 18720.604 | 6174.435 |
| B5 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds | 17354.297 | 18736.694 | 6184.307 |
| B6 | Total Cholesterol, Cigarette Category, Sex, Age, SBP | 17692.309 | 19135.546 | 6292.885 |
| B7 | Total Cholesterol, Cigarette Category, Sex, Age, BP\_Meds | 17498.227 | 18832.719 | 6259.920 |
| B8 | Total Cholesterol, Cigarette Category, Sex, Age, Diabetes, BMI | 17686.540 | 19099.878 | 6321.740 |
| B9 | Total Cholesterol, Cigarette Category, Sex, Age, Diabetes | 17823.262 | 19230.967 | 6382.562 |
| B10 | Total Cholesterol, Cigarette Category, Sex, Age, BMI | 17719.230 | 19117.457 | 6331.885 |
| B11 | Total Cholesterol, Cigarette Category, Sex, Age | 17865.377 | 19256.106 | 6396.214 |

**Table 7**: SBC values for Cox proportional hazard models with logarithmically transformed continuous variables

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **Covariates** | **SBC Values** | | |
| **CVD** | **CHD** | **Stroke** |
| C | Log Total Cholesterol, Cigarette Category, Sex, Log Age, Log SBP, BP\_Meds, Diabetes, Log BMI | 17222.656 | 18624.123 | 6127.548 |

**Table 8**: SBC values for Cox proportional hazard models with interaction terms

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **Covariates** | **SBC Values** | | |
| **CVD** | **CHD** | **Stroke** |
| D1 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI, total\_chol\*age | 17218.851 | 18623.479 | 6132.931 |
| D2 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI, total\_chol\*sex | 17227.769 | 18630.692 | 6131.973 |
| D3 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI, cigarette\_cat\*age | 17234.640 | 18641.426 | 6140.327 |
| D4 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI, cigarette\_cat\*sex | 17239.428 | 18644.196 | 6145.981 |
| D5 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI, sbp\*age | 17227.997 | 18630.819 | 6134.558 |
| D6 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI, sbp\*sex | 17228.365 | 18630.168 | 6135.025 |
| D7 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI, diabetes\*age | 17225.991 | 18627.899 | 6132.961 |
| D8 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI, diabetes\*sex | 17227.538 | 18630.565 | 6134.421 |
| D9 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI, bmi\*age | 17227.970 | 18628.161 | 6135.194 |
| D10 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI, bmi\*sex | 17228.303 | 18630.830 | 6135.090 |
| D11 | Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI, total\_chol\*cigarette\_cat | 17240.466 | 18644.435 | 6150.721 |

**Table 9**: Cox proportional hazard model regression coefficients for CVD among males

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Parameter Estimate** | **Hazard Ratio** | **95% Hazard Ratio Confidence Interval** | **p-value** |
| Total Cholesterol | 0.00339 | 1.003 | 1.002-1.005 | <0.0001 |
| 1-10 Cigarettes | 0.16939 | 1.185 | 0.908-1.545 | 0.2112 |
| 11-20 Cigarettes | 0.31857 | 1.375 | 1.137-1.663 | 0.0010 |
| 21+ Cigarettes | 0.30807 | 1.361 | 1.090-1.698 | 0.0064 |
| Age | 0.05698 | 1.059 | 1.048-1.069 | <0.0001 |
| Systolic Blood Pressure | 0.01447 | 1.015 | 1.011-1.019 | <0.0001 |
| BP Meds | 0.54776 | 1.729 | 1.133-2.639 | 0.0111 |
| Diabetes | 0.70138 | 2.017 | 1.429-2.639 | <0.0001 |
| BMI | 0.02884 | 1.029 | 1.005-1.054 | 0.0173 |

**Table 10**: Cox proportional hazard model regression coefficients for CHD among males

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Parameter Estimate** | **Hazard Ratio** | **95% Hazard Ratio Confidence Interval** | **p-value** |
| Total Cholesterol | 0.00407 | 1.004 | 1.003-1.006 | <0.0001 |
| 1-10 Cigarettes | 0.10019 | 1.105 | 0.849-1.438 | 0.4558 |
| 11-20 Cigarettes | 0.21978 | 1.246 | 1.032-1.504 | 0.0220 |
| 21+ Cigarettes | 0.30208 | 1.353 | 1.094-1.673 | 0.0053 |
| Age | 0.04598 | 1.047 | 1.037-1.057 | <0.0001 |
| Systolic Blood Pressure | 0.01055 | 1.011 | 1.007-1.015 | <0.0001 |
| BP Meds | 0.31260 | 1.367 | 0.876-2.133 | 0.1684 |
| Diabetes | 0.57042 | 1.769 | 1.223-2.539 | 0.0020 |
| BMI | 0.03732 | 1.038 | 1.014-1.062 | 0.0014 |

**Table 11**: Cox proportional hazard model regression coefficients for stroke among males

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Parameter Estimate** | **Hazard Ratio** | **95% Hazard Ratio Confidence Interval** | **p-value** |
| Total Cholesterol | 0.0003558 | 1.001 | 0.997-1.004 | 0.7554 |
| 1-10 Cigarettes | 0.16839 | 1.144 | 0.697-1.877 | 0.5949 |
| 11-20 Cigarettes | 0.53980 | 1.725 | 1.226-2.426 | 0.0018 |
| 21+ Cigarettes | 0.17683 | 1.150 | 0.728-1.815 | 0.5493 |
| Age | 0.09237 | 1.097 | 1.076-1.118 | <0.0001 |
| Systolic Blood Pressure | 0.01865 | 1.019 | 1.012-1.026 | <0.0001 |
| BP Meds | 1.04148 | 2.833 | 1.502-5.344 | 0.0013 |
| Diabetes | 1.09311 | 2.984 | 1.700-5.236 | 0.0004 |
| BMI | 0.01682 | 1.017 | 0.972-1.064 | 0.4687 |

**Table 12**: Cox proportional hazard model regression coefficients for CVD among females

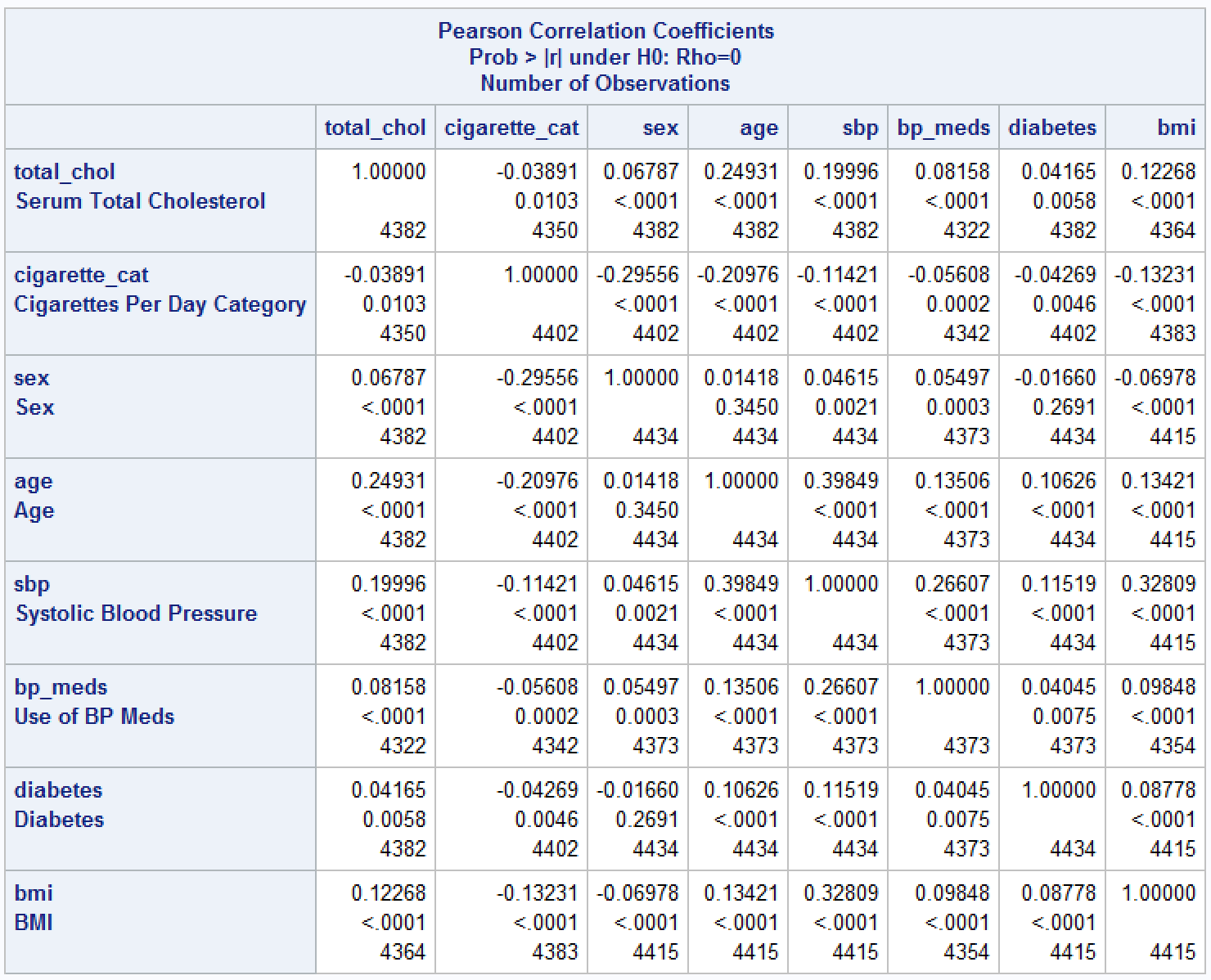
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Parameter Estimate** | **Hazard Ratio** | **95% Hazard Ratio Confidence Interval** | **p-value** |
| Total Cholesterol | 0.00246 | 1.002 | 1.000-1.005 | 0.0213 |
| 1-10 Cigarettes | 0.22444 | 1.252 | 0.966-1.621 | 0.0890 |
| 11-20 Cigarettes | 0.60593 | 1.833 | 1.422-2.363 | <0.0001 |
| 21+ Cigarettes | 0.32654 | 1.386 | 0.789-2.436 | 0.2565 |
| Age | 0.06240 | 1.064 | 1.050-1.079 | <0.0001 |
| Systolic Blood Pressure | 0.01617 | 1.016 | 1.012-1.020 | <0.0001 |
| BP Meds | 0.24215 | 1.274 | 0.909-1.785 | 0.1591 |
| Diabetes | 0.94093 | 2.562 | 1.794-3.659 | <0.0001 |
| BMI | 0.02593 | 1.026 | 1.007-1.046 | 0.0084 |

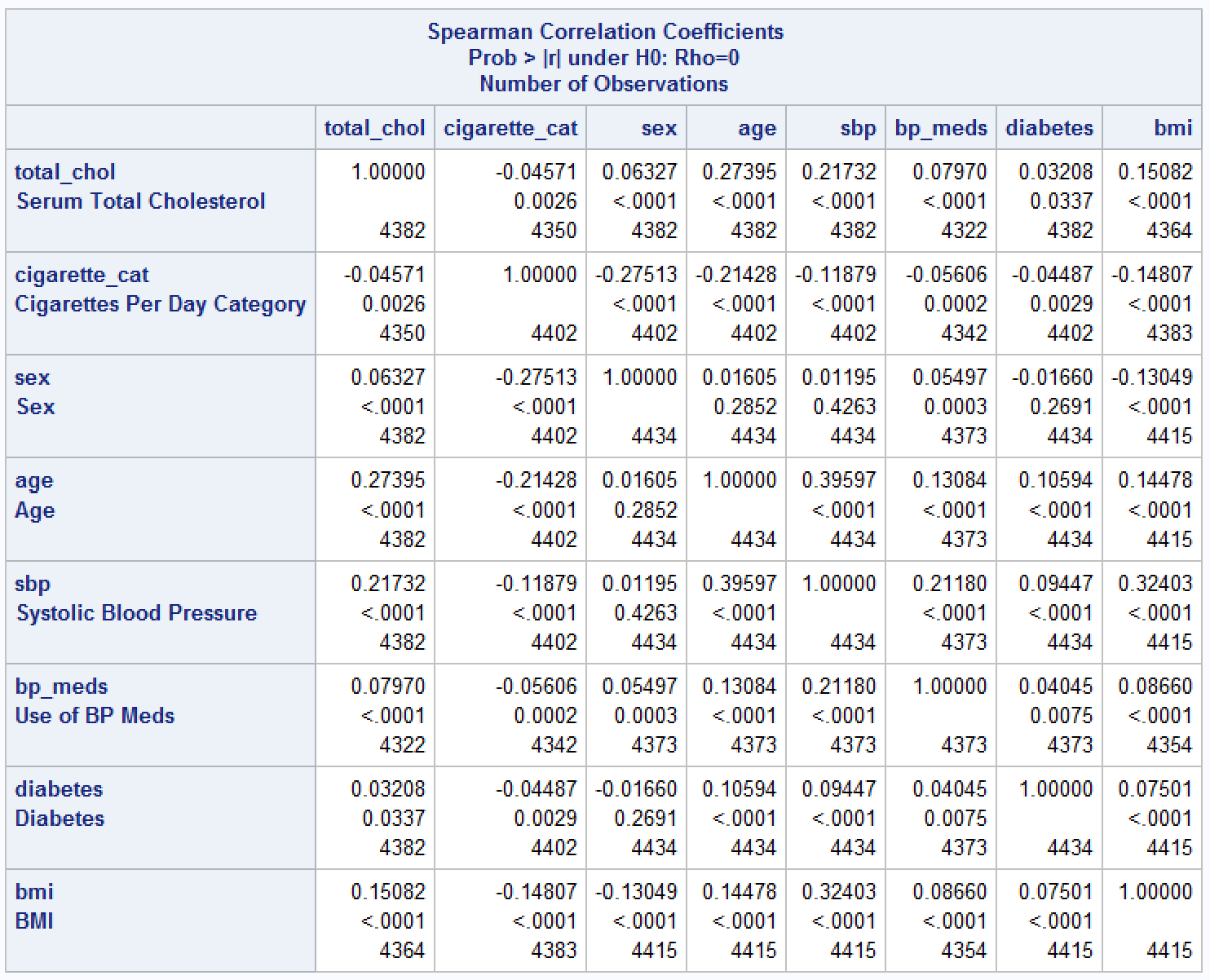
**Table 13**: Cox proportional hazard model regression coefficients for CHD among females

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Parameter Estimate** | **Hazard Ratio** | **95% Hazard Ratio Confidence Interval** | **p-value** |
| Total Cholesterol | 0.00454 | 1.005 | 1.003-1.007 | <0.0001 |
| 1-10 Cigarettes | 0.04746 | 1.049 | 0.818-1.344 | 0.7076 |
| 11-20 Cigarettes | 0.18591 | 1.204 | 0.933-1.555 | 0.1535 |
| 21+ Cigarettes | 0.04278 | 1.044 | 0.607-1.794 | 0.8770 |
| Age | 0.04184 | 1.043 | 1.029-1.056 | <0.0001 |
| Systolic Blood Pressure | 0.01314 | 1.014 | 1.009-1.017 | <0.0001 |
| BP Meds | 0.37257 | 1.451 | 1.056-1.995 | 0.0217 |
| Diabetes | 0.71362 | 2.041 | 1.405-2.967 | 0.0002 |
| BMI | 0.03435 | 1.035 | 1.016-1.054 | 0.0003 |

**Table 14**: Cox proportional hazard model regression coefficients for stroke among females

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Parameter Estimate** | **Hazard Ratio** | **95% Hazard Ratio Confidence Interval** | **p-value** |
| Total Cholesterol | -0.00358 | 0.996 | 0.996-1.000 | 0.0273 |
| 1-10 Cigarettes | 0.24007 | 1.271 | 0.863-1.873 | 0.2249 |
| 11-20 Cigarettes | 0.74361 | 2.104 | 1.463-3.024 | <0.0001 |
| 21+ Cigarettes | 0.18368 | 1.202 | 0.488-2.962 | 0.6898 |
| Age | 0.08277 | 1.086 | 1.065-1.108 | <0.0001 |
| Systolic Blood Pressure | 0.01920 | 1.019 | 1.014-1.025 | <0.0001 |
| BP Meds | 0.62296 | 1.864 | 1.219-2.852 | 0.0041 |
| Diabetes | 0.69638 | 2.007 | 1.150-3.505 | 0.0143 |
| BMI | 0.01759 | 1.018 | 0.990-1.046 | 0.2111 |

****

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**SAS Code**

libname project "C:/Irene Hsueh's Documents/MS Applied Biostatistics/BS 853 - Generalized Linear Models with Applications/Project";

**proc** **format**;

value sex\_format **1**="Male" **2**="Female";

value bp\_meds\_format **1**="BP Meds" **0**="No BP Meds";

value chol\_format **1**="<200" **2**="200 - 219" **3**="220 - 259" **4**="260+";

value smoking\_format **1**="Smoker" **0**="Not Smoker";

value cigarette\_format **1**="0 Cigarettes" **2**="1-10 Cigarettes" **3**="11-20 Cigarettes" **4**="21+ Cigarettes";

value diabetes\_format **1**="Diabetes" **0**="No Diabetes";

value cvd\_format **1**="CVD" **0**="No CVD";

value chd\_format **1**="CHD" **0**="No CHD";

value stroke\_format **1**="Stroke" **0**="No Stroke";

**run**;

**data** framingham;

set project.framingham

(keep = randid sex age period sysbp diabp bpmeds heartrte totchol

cursmoke cigpday bmi glucose diabetes

cvd anychd stroke timechd timecvd timestrk

rename=(randid=id sex=sex age=age period=exam

sysbp=sbp diabp=dbp bpmeds=bp\_meds heartrte=bpm totchol=total\_chol

cursmoke=smoking\_status cigpday=cigarettes bmi=bmi glucose=glucose diabetes=diabetes

cvd=cvd anychd=chd stroke=stroke

timecvd=time\_cvd timechd=time\_chd timestrk=time\_stroke));

attrib

id label="ID"

sex label="Sex" format=sex\_format.

age label="Age"

exam label="Exam #"

sbp label="Systolic Blood Pressure"

dbp label="Diastolic Blood Pressure"

bp\_meds label="Use of BP Meds" format=bp\_meds\_format.

bpm label="Heart Rate (bpm)"

total\_chol label="Serum Total Cholesterol"

chol\_cat label="Cholesterol Category" format=chol\_format.

smoking\_status label="Smoking Status" format=smoking\_format.

cigarettes label="Number of Cigarettes Smoked per Day"

cigarette\_cat label="Cigarettes Per Day Category" format=cigarette\_format.

bmi label="BMI"

glucose label="Serum Glucose"

diabetes label="Diabetes" format=diabetes\_format.

cvd label="Cardiovascular Disease" format=cvd\_format.

chd label="Coronary Heart Disease" format=chd\_format.

stroke label="Stroke" format=stroke\_format.

time\_cvd label="Time to CVD (Days)"

time\_chd label="Time to CHD (Days)"

time\_stroke label="Time to Stroke (Days)"

;

if total\_chol < **200** then chol\_cat=**1**;

else if **200** <= total\_chol < **220** then chol\_cat=**2**;

else if **220** <= total\_chol < **260** then chol\_cat=**3**;

else if total\_chol >= **260** then chol\_cat=**4**;

if cigarettes = **0** then cigarette\_cat=**1**;

else if **1** <= cigarettes <= **10** then cigarette\_cat=**2**;

else if **11** <= cigarettes <= **20** then cigarette\_cat=**3**;

else if cigarettes >= **21** then cigarette\_cat=**4**;

log\_age = log(age);

log\_cigarettes = log(cigarettes + **1**);

log\_sbp = log(sbp);

log\_chol = log(total\_chol);

log\_bmi = log(bmi);

**run**;

**proc** **print** data=framingham (obs=**20**) label;

**run**;

/\* Descriptive Statistics \*/

title "Overall Descriptive Statistics";

**proc** **freq** data=framingham;

where exam=**1**;

tables bp\_meds chol\_cat smoking\_status cigarette\_cat diabetes cvd chd stroke / nocum;

**run**;

title;

title "Overall Descriptive Statistics";

**proc** **means** data=framingham maxdec=**2**;

where exam=**1**;

var age sbp dbp bpm total\_chol cigarettes bmi glucose time\_cvd time\_chd time\_stroke;

**run**;

title;

**proc** **sort** data=framingham;

by sex;

**run**;

title "Descriptive Statistics by Sex";

**proc** **freq** data=framingham;

where exam=**1**;

tables bp\_meds\*sex chol\_cat\*sex smoking\_status\*sex cigarette\_cat\*sex

diabetes\*sex cvd\*sex chd\*sex stroke\*sex / nopercent norow nocum chisq;

**run**;

title;

title "Descriptive Statistics by Sex";

**proc** **means** data=framingham maxdec=**2**;

where exam=**1**;

by sex;

var age sbp dbp bpm total\_chol cigarettes bmi glucose time\_cvd time\_chd time\_stroke;

**run**;

title;

title "Two-Sample T-Test by Sex";

**proc** **ttest** data=framingham;

where exam=**1**;

class sex;

var age sbp dbp bpm total\_chol cigarettes bmi glucose time\_cvd time\_chd time\_stroke;

**run**;

title;

/\* Data Exploration \*/

title "Checking Distribution of Continuous Variables and Identifying Outliers";

**proc** **univariate** data=framingham plots;

where exam=**1**;

var age log\_age cigarettes log\_cigarettes sbp bp\_meds log\_sbp total\_chol log\_chol bmi log\_bmi;

histogram / normal;

**run**;

title;

title "Correlation Between Variables";

**proc** **corr** data=framingham pearson spearman;

where exam=**1**;

var total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi;

**run**;

title;

/\* Final Cox Proportional Hazards Models \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = chol\_cat smoking\_status sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = chol\_cat smoking\_status sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = chol\_cat smoking\_status sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

ODS HTML close;

ODS HTML;

/\* Model A1: Cholesterol Category, Smoking Status, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = chol\_cat smoking\_status sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = chol\_cat smoking\_status sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = chol\_cat smoking\_status sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

/\* Model A2: Total Cholesterol, Smoking Status, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol smoking\_status sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol smoking\_status sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol smoking\_status sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

/\* Model A3: Cholesterol Category, Cigarettes, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = chol\_cat cigarettes sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds") smoking\_status(ref="Not Smoker") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = chol\_cat cigarettes sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds") smoking\_status(ref="Not Smoker") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = chol\_cat cigarettes sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

/\* Model A4: Total Cholesterol, Cigarettes, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarettes sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarettes sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarettes sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

/\* Model A5: Cholesterol Category, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = chol\_cat cigarette\_cat sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = chol\_cat cigarette\_cat sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = chol\_cat cigarette\_cat sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

/\* Model A6: Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

ODS HTML close;

ODS HTML;

/\* Model B1: Total Cholesterol, Cigarette Category, Sex, Age, SBP, Diabetes, BMI \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp diabetes bmi / risklimits;

**run**;

title;

/\* Model B2: Total Cholesterol, Cigarette Category, Sex, Age, BP\_Meds, Diabetes, BMI \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age bp\_meds diabetes bmi / risklimits;

**run**;

title;

/\* Model B3: Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds BMI \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds bmi / risklimits;

**run**;

title;

/\* Model B4: Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes / risklimits;

**run**;

title;

/\* Model B5: Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds / risklimits;

**run**;

title;

/\* Model B6: Total Cholesterol, Cigarette Category, Sex, Age, SBP \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp / risklimits;

**run**;

title;

/\* Model B7: Total Cholesterol, Cigarette Category, Sex, Age, BP\_Meds \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age bp\_meds / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age bp\_meds / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age bp\_meds / risklimits;

**run**;

title;

/\* Model B8: Total Cholesterol, Cigarette Category, Sex, Age, Diabetes, BMI \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age diabetes bmi / risklimits;

**run**;

title;

/\* Model B9: Total Cholesterol, Cigarette Category, Sex, Age, Diabetes \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age diabetes / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age diabetes / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age diabetes / risklimits;

**run**;

title;

/\* Model B10: Total Cholesterol, Cigarette Category, Sex, Age, BMI \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age bmi / risklimits;

**run**;

title;

/\* Model B11: Total Cholesterol, Cigarette Category, Sex, Age \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age / risklimits;

**run**;

title;

ODS HTML close;

ODS HTML;

/\* Model C: Logarithmically Transformed Continuous Variables \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = log\_chol cigarette\_cat sex log\_age log\_sbp bp\_meds diabetes log\_bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = log\_chol cigarette\_cat sex log\_age log\_sbp bp\_meds diabetes log\_bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = log\_chol cigarette\_cat sex log\_age log\_sbp bp\_meds diabetes log\_bmi / risklimits;

**run**;

title;

ODS HTML close;

ODS HTML;

/\* Model D1: Interaction Between Total Cholesterol and Age \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi total\_chol\*age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi total\_chol\*age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi total\_chol\*age / risklimits;

**run**;

title;

/\* Model D2: Interaction Between Total Cholesterol and Sex \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp diabetes bmi total\_chol\*sex / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi total\_chol\*sex / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi total\_chol\*sex / risklimits;

**run**;

title;

/\* Model D3: Interaction Between Cigarette Category and Age \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi cigarette\_cat\*age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi cigarette\_cat\*age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi cigarette\_cat\*age / risklimits;

**run**;

title;

/\* Model D4: Interaction Between Cigarette Category and Sex \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi cigarette\_cat\*sex / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi cigarette\_cat\*sex / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi cigarette\_cat\*sex / risklimits;

**run**;

title;

/\* Model D5: Interaction Between SBP and Age \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi sbp\*age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi sbp\*age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi sbp\*age / risklimits;

**run**;

title;

/\* Model D6: Interaction Between SBP and Sex \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi sbp\*sex / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi sbp\*sex / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi sbp\*sex / risklimits;

**run**;

title;

/\* Model D7: Interaction Between Diabetes and Age \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi diabetes\*age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi diabetes\*age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi diabetes\*age / risklimits;

**run**;

title;

/\* Model D8: Interaction Between Diabetes and Sex \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi diabetes\*sex / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi diabetes\*sex / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi diabetes\*sex / risklimits;

**run**;

title;

/\* Model D9: Interaction Between BMI and Age \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*age / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*age / risklimits;

**run**;

title;

/\* Model D10: Interaction Between Diabetes and Sex \*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*sex / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*sex / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*sex / risklimits;

**run**;

title;

/\* Model D11: Interaction Between Total Cholesterol and Cigarette Category\*/

title "Cox Proportion Hazards Model for CVD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol | cigarette\_cat sex age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol | cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*sex / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke";

**proc** **phreg** data=framingham;

where exam=**1**;

class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol | cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*sex / risklimits;

**run**;

title;

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ODS HTML;

/\* Model Cox Proportional Hazards for Males \*/

title "Cox Proportion Hazards Model for CVD among Males";

**proc** **phreg** data=framingham;

where exam=**1** and sex=**1**;

class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD among Males";

**proc** **phreg** data=framingham;

where exam=**1** and sex=**1**;

class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke among Males";

**proc** **phreg** data=framingham;

where exam=**1** and sex=**1**;

class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

/\* Cox Proportional Hazards for Females \*/

title "Cox Proportion Hazards Model for CVD among Females";

**proc** **phreg** data=framingham;

where exam=**1** and sex=**2**;

class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_cvd\*cvd(**0**) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for CHD among Females";

**proc** **phreg** data=framingham;

where exam=**1** and sex=**2**;

class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_chd\*chd(**0**) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

title "Cox Proportion Hazards Model for Stroke among Females";

**proc** **phreg** data=framingham;

where exam=**1** and sex=**2**;

class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

model time\_stroke\*stroke(**0**) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi / risklimits;

**run**;

title;

**SAS Log**

NOTE: Copyright (c) 2016 by SAS Institute Inc., Cary, NC, USA.

NOTE: SAS (r) Proprietary Software 9.4 (TS1M6)

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NOTE: This session is executing on the W32\_10PRO platform.

NOTE: Analytical products:

SAS/STAT 15.1

SAS/ETS 15.1

SAS/IML 15.1

SAS/QC 15.1

NOTE: Additional host information:

W32\_10PRO WIN 10.0.19041 Workstation

NOTE: SAS initialization used:

real time 1.30 seconds

cpu time 0.95 seconds

1 libname project "C:/Irene Hsueh's Documents/MS Applied Biostatistics/BS 853 - Generalized Linear

1 ! Models with Applications/Project";

NOTE: Libref PROJECT was successfully assigned as follows:

Engine: V9

Physical Name: C:\Irene Hsueh's Documents\MS Applied Biostatistics\BS 853 - Generalized Linear

Models with Applications\Project

2 proc format;

3 value sex\_format 1="Male" 2="Female";

NOTE: Format SEX\_FORMAT has been output.

4 value bp\_meds\_format 1="BP Meds" 0="No BP Meds";

NOTE: Format BP\_MEDS\_FORMAT has been output.

5 value chol\_format 1="<200" 2="200 - 219" 3="220 - 259" 4="260+";

NOTE: Format CHOL\_FORMAT has been output.

6 value smoking\_format 1="Smoker" 0="Not Smoker";

NOTE: Format SMOKING\_FORMAT has been output.

7 value cigarette\_format 1="0 Cigarettes" 2="1-10 Cigarettes" 3="11-20 Cigarettes" 4="21+

7 ! Cigarettes";

NOTE: Format CIGARETTE\_FORMAT has been output.

8 value diabetes\_format 1="Diabetes" 0="No Diabetes";

NOTE: Format DIABETES\_FORMAT has been output.

9 value cvd\_format 1="CVD" 0="No CVD";

NOTE: Format CVD\_FORMAT has been output.

10 value chd\_format 1="CHD" 0="No CHD";

NOTE: Format CHD\_FORMAT has been output.

11 value stroke\_format 1="Stroke" 0="No Stroke";

NOTE: Format STROKE\_FORMAT has been output.

12 run;

NOTE: PROCEDURE FORMAT used (Total process time):

real time 0.04 seconds

cpu time 0.03 seconds

13

14 data framingham;

15 set project.framingham

16 (keep = randid sex age period sysbp diabp bpmeds heartrte totchol

17 cursmoke cigpday bmi glucose diabetes

18 cvd anychd stroke timechd timecvd timestrk

19 rename=(randid=id sex=sex age=age period=exam

20 sysbp=sbp diabp=dbp bpmeds=bp\_meds heartrte=bpm totchol=total\_chol

21 cursmoke=smoking\_status cigpday=cigarettes bmi=bmi glucose=glucose

21 ! diabetes=diabetes

22 cvd=cvd anychd=chd stroke=stroke

23 timecvd=time\_cvd timechd=time\_chd timestrk=time\_stroke));

NOTE: Data file PROJECT.FRAMINGHAM.DATA is in a format that is native to another host, or the file

encoding does not match the session encoding. Cross Environment Data Access will be used, which

might require additional CPU resources and might reduce performance.

24 attrib

25 id label="ID"

26 sex label="Sex" format=sex\_format.

27 age label="Age"

28 exam label="Exam #"

29 sbp label="Systolic Blood Pressure"

30 dbp label="Diastolic Blood Pressure"

31 bp\_meds label="Use of BP Meds" format=bp\_meds\_format.

32 bpm label="Heart Rate (bpm)"

33 total\_chol label="Serum Total Cholesterol"

34 chol\_cat label="Cholesterol Category" format=chol\_format.

35 smoking\_status label="Smoking Status" format=smoking\_format.

36 cigarettes label="Number of Cigarettes Smoked per Day"

37 cigarette\_cat label="Cigarettes Per Day Category" format=cigarette\_format.

38 bmi label="BMI"

39 glucose label="Serum Glucose"

40 diabetes label="Diabetes" format=diabetes\_format.

41 cvd label="Cardiovascular Disease" format=cvd\_format.

42 chd label="Coronary Heart Disease" format=chd\_format.

43 stroke label="Stroke" format=stroke\_format.

44 time\_cvd label="Time to CVD (Days)"

45 time\_chd label="Time to CHD (Days)"

46 time\_stroke label="Time to Stroke (Days)"

47 ;

48 if total\_chol < 200 then chol\_cat=1;

49 else if 200 <= total\_chol < 220 then chol\_cat=2;

50 else if 220 <= total\_chol < 260 then chol\_cat=3;

51 else if total\_chol >= 260 then chol\_cat=4;

52

53 if cigarettes = 0 then cigarette\_cat=1;

54 else if 1 <= cigarettes <= 10 then cigarette\_cat=2;

55 else if 11 <= cigarettes <= 20 then cigarette\_cat=3;

56 else if cigarettes >= 21 then cigarette\_cat=4;

57

58 log\_age = log(age);

59 log\_cigarettes = log(cigarettes + 1);

60 log\_sbp = log(sbp);

61 log\_chol = log(total\_chol);

62 log\_bmi = log(bmi);

63 run;

NOTE: Missing values were generated as a result of performing an operation on missing values.

Each place is given by: (Number of times) at (Line):(Column).

79 at 59:22 79 at 59:37 409 at 61:16 52 at 62:15

NOTE: There were 11627 observations read from the data set PROJECT.FRAMINGHAM.

NOTE: The data set WORK.FRAMINGHAM has 11627 observations and 27 variables.

NOTE: DATA statement used (Total process time):

real time 0.12 seconds

cpu time 0.12 seconds

64

65 proc print data=framingham (obs=20) label;

NOTE: Writing HTML Body file: sashtml.htm

66 run;

NOTE: There were 20 observations read from the data set WORK.FRAMINGHAM.

NOTE: PROCEDURE PRINT used (Total process time):

real time 0.46 seconds

cpu time 0.09 seconds

67

68

69

70 /\* Descriptive Statistics \*/

71 title "Overall Descriptive Statistics";

72 proc freq data=framingham;

73 where exam=1;

74 tables bp\_meds chol\_cat smoking\_status cigarette\_cat diabetes cvd chd stroke / nocum;

75 run;

NOTE: There were 4434 observations read from the data set WORK.FRAMINGHAM.

WHERE exam=1;

NOTE: PROCEDURE FREQ used (Total process time):

real time 0.06 seconds

cpu time 0.04 seconds

76 title;

77

78 title "Overall Descriptive Statistics";

79 proc means data=framingham maxdec=2;

80 where exam=1;

81 var age sbp dbp bpm total\_chol cigarettes bmi glucose time\_cvd time\_chd time\_stroke;

82 run;

NOTE: There were 4434 observations read from the data set WORK.FRAMINGHAM.

WHERE exam=1;

NOTE: PROCEDURE MEANS used (Total process time):

real time 0.11 seconds

cpu time 0.01 seconds

83 title;

84

85

86

87 proc sort data=framingham;

88 by sex;

89 run;

NOTE: There were 11627 observations read from the data set WORK.FRAMINGHAM.

NOTE: The data set WORK.FRAMINGHAM has 11627 observations and 27 variables.

NOTE: PROCEDURE SORT used (Total process time):

real time 0.03 seconds

cpu time 0.01 seconds

90

91 title "Descriptive Statistics by Sex";

92 proc freq data=framingham;

93 where exam=1;

94 tables bp\_meds\*sex chol\_cat\*sex smoking\_status\*sex cigarette\_cat\*sex

95 diabetes\*sex cvd\*sex chd\*sex stroke\*sex / nopercent norow nocum chisq;

96 run;

NOTE: There were 4434 observations read from the data set WORK.FRAMINGHAM.

WHERE exam=1;

NOTE: PROCEDURE FREQ used (Total process time):

real time 0.09 seconds

cpu time 0.06 seconds

97 title;

98

99 title "Descriptive Statistics by Sex";

100 proc means data=framingham maxdec=2;

101 where exam=1;

102 by sex;

103 var age sbp dbp bpm total\_chol cigarettes bmi glucose time\_cvd time\_chd time\_stroke;

104 run;

NOTE: There were 4434 observations read from the data set WORK.FRAMINGHAM.

WHERE exam=1;

NOTE: PROCEDURE MEANS used (Total process time):

real time 0.06 seconds

cpu time 0.04 seconds

105 title;

106

107 title "Two-Sample T-Test by Sex";

108 proc ttest data=framingham;

109 where exam=1;

110 class sex;

111 var age sbp dbp bpm total\_chol cigarettes bmi glucose time\_cvd time\_chd time\_stroke;

112 run;

NOTE: PROCEDURE TTEST used (Total process time):

real time 19.31 seconds

cpu time 6.73 seconds

113 title;

114

115

116

117

118 /\* Data Exploration \*/

119 title "Checking Distribution of Continuous Variables and Identifying Outliers";

120 proc univariate data=framingham plots;

121 where exam=1;

122 var age log\_age cigarettes log\_cigarettes sbp log\_sbp total\_chol log\_chol bmi log\_bmi;

123 histogram / normal;

124 run;

NOTE: PROCEDURE UNIVARIATE used (Total process time):

real time 6.34 seconds

cpu time 1.84 seconds

125 title;

126

127 title "Correlation Between Variables";

128 proc corr data=framingham pearson spearman;

129 where exam=1;

130 var total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi;

131 run;

NOTE: PROCEDURE CORR used (Total process time):

real time 0.05 seconds

cpu time 0.03 seconds

132 title;

133

134

135

136

137 /\* Final Cox Proportional Hazards Models \*/

138 title "Cox Proportion Hazards Model for CVD";

139 proc phreg data=framingham zph;

140 where exam=1;

141 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") /

141! param=ref;

142 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi /

142! risklimits;

143 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 6.60 seconds

cpu time 5.67 seconds

144 title;

145

146 title "Cox Proportion Hazards Model for CHD";

147 proc phreg data=framingham zph;

148 where exam=1;

149 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") /

149! param=ref;

150 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi /

150! risklimits;

151 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 6.97 seconds

cpu time 5.85 seconds

152 title;

153

154 title "Cox Proportion Hazards Model for Stroke";

155 proc phreg data=framingham zph;

156 where exam=1;

157 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") /

157! param=ref;

158 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi /

158! risklimits;

159 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 1.49 seconds

cpu time 0.90 seconds

160 title;

161

162

163

164 ODS HTML close;

165 ODS HTML;

NOTE: Writing HTML Body file: sashtml1.htm

166

167

168

169 /\* Model A1: Cholesterol Category, Smoking Status, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

170 title "Cox Proportion Hazards Model for CVD";

171 proc phreg data=framingham;

172 where exam=1;

173 class chol\_cat(ref="<200") smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No

173! BP Meds") diabetes(ref="No Diabetes") / param=ref;

174 model time\_cvd\*cvd(0) = chol\_cat smoking\_status sex age sbp bp\_meds diabetes bmi / risklimits

174! ;

175 run;

NOTE: 80 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

176 title;

177

178 title "Cox Proportion Hazards Model for CHD";

179 proc phreg data=framingham;

180 where exam=1;

181 class chol\_cat(ref="<200") smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No

181! BP Meds") diabetes(ref="No Diabetes") / param=ref;

182 model time\_chd\*chd(0) = chol\_cat smoking\_status sex age sbp bp\_meds diabetes bmi / risklimits

182! ;

183 run;

NOTE: 80 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.11 seconds

184 title;

185

186 title "Cox Proportion Hazards Model for Stroke";

187 proc phreg data=framingham;

188 where exam=1;

189 class chol\_cat(ref="<200") smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No

189! BP Meds") diabetes(ref="No Diabetes") / param=ref;

190 model time\_stroke\*stroke(0) = chol\_cat smoking\_status sex age sbp bp\_meds diabetes bmi /

190! risklimits;

191 run;

NOTE: 80 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.09 seconds

192 title;

193

194

195

196 /\* Model A2: Total Cholesterol, Smoking Status, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

197 title "Cox Proportion Hazards Model for CVD";

198 proc phreg data=framingham;

199 where exam=1;

200 class smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds")

200! diabetes(ref="No Diabetes") / param=ref;

201 model time\_cvd\*cvd(0) = total\_chol smoking\_status sex age sbp bp\_meds diabetes bmi /

201! risklimits;

202 run;

NOTE: 130 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

203 title;

204

205 title "Cox Proportion Hazards Model for CHD";

206 proc phreg data=framingham;

207 where exam=1;

208 class smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds")

208! diabetes(ref="No Diabetes") / param=ref;

209 model time\_chd\*chd(0) = total\_chol smoking\_status sex age sbp bp\_meds diabetes bmi /

209! risklimits;

210 run;

NOTE: 130 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.09 seconds

211 title;

212

213 title "Cox Proportion Hazards Model for Stroke";

214 proc phreg data=framingham;

215 where exam=1;

216 class smoking\_status(ref="Not Smoker") sex(ref="Female") bp\_meds(ref="No BP Meds")

216! diabetes(ref="No Diabetes") / param=ref;

217 model time\_stroke\*stroke(0) = total\_chol smoking\_status sex age sbp bp\_meds diabetes bmi /

217! risklimits;

218 run;

NOTE: 130 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.09 seconds

219 title;

220

221

222

223 /\* Model A3: Cholesterol Category, Cigarettes, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

224 title "Cox Proportion Hazards Model for CVD";

225 proc phreg data=framingham;

226 where exam=1;

227 class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No

227! Diabetes") / param=ref;

228 model time\_cvd\*cvd(0) = chol\_cat cigarettes sex age sbp bp\_meds diabetes bmi / risklimits;

229 run;

NOTE: 111 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

230 title;

231

232 title "Cox Proportion Hazards Model for CHD";

233 proc phreg data=framingham;

234 where exam=1;

235 class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds")

235! smoking\_status(ref="Not Smoker") diabetes(ref="No Diabetes") / param=ref;

236 model time\_chd\*chd(0) = chol\_cat cigarettes sex age sbp bp\_meds diabetes bmi / risklimits;

237 run;

NOTE: 111 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.09 seconds

238 title;

239

240 title "Cox Proportion Hazards Model for Stroke";

241 proc phreg data=framingham;

242 where exam=1;

243 class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds")

243! smoking\_status(ref="Not Smoker") diabetes(ref="No Diabetes") / param=ref;

244 model time\_stroke\*stroke(0) = chol\_cat cigarettes sex age sbp bp\_meds diabetes bmi /

244! risklimits;

245 run;

NOTE: 111 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.09 seconds

246 title;

247

248

249

250 /\* Model A4: Total Cholesterol, Cigarettes, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

251 title "Cox Proportion Hazards Model for CVD";

252 proc phreg data=framingham;

253 where exam=1;

254 class sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

255 model time\_cvd\*cvd(0) = total\_chol cigarettes sex age sbp bp\_meds diabetes bmi / risklimits;

256 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

257 title;

258

259 title "Cox Proportion Hazards Model for CHD";

260 proc phreg data=framingham;

261 where exam=1;

262 class sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

263 model time\_chd\*chd(0) = total\_chol cigarettes sex age sbp bp\_meds diabetes bmi / risklimits;

264 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.06 seconds

265 title;

266

267 title "Cox Proportion Hazards Model for Stroke";

268 proc phreg data=framingham;

269 where exam=1;

270 class sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes") / param=ref;

271 model time\_stroke\*stroke(0) = total\_chol cigarettes sex age sbp bp\_meds diabetes bmi /

271! risklimits;

272 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

273 title;

274

275

276

277 /\* Model A5: Cholesterol Category, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

278 title "Cox Proportion Hazards Model for CVD";

279 proc phreg data=framingham;

280 where exam=1;

281 class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No

281! Diabetes") / param=ref;

282 model time\_cvd\*cvd(0) = chol\_cat cigarette\_cat sex age sbp bp\_meds diabetes bmi / risklimits;

283 run;

NOTE: 111 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.11 seconds

cpu time 0.09 seconds

284 title;

285

286 title "Cox Proportion Hazards Model for CHD";

287 proc phreg data=framingham;

288 where exam=1;

289 class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No

289! Diabetes") / param=ref;

290 model time\_chd\*chd(0) = chol\_cat cigarette\_cat sex age sbp bp\_meds diabetes bmi / risklimits;

291 run;

NOTE: 111 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.11 seconds

cpu time 0.07 seconds

292 title;

293

294 title "Cox Proportion Hazards Model for Stroke";

295 proc phreg data=framingham;

296 where exam=1;

297 class chol\_cat(ref="<200") sex(ref="Female") bp\_meds(ref="No BP Meds") diabetes(ref="No

297! Diabetes") / param=ref;

298 model time\_stroke\*stroke(0) = chol\_cat cigarette\_cat sex age sbp bp\_meds diabetes bmi /

298! risklimits;

299 run;

NOTE: 111 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

300 title;

301

302

303

304 /\* Model A6: Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes, BMI \*/

305 title "Cox Proportion Hazards Model for CVD";

306 proc phreg data=framingham;

307 where exam=1;

308 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

308! diabetes(ref="No Diabetes") / param=ref;

309 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi /

309! risklimits;

310 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

311 title;

312

313 title "Cox Proportion Hazards Model for CHD";

314 proc phreg data=framingham;

315 where exam=1;

316 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

316! diabetes(ref="No Diabetes") / param=ref;

317 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi /

317! risklimits;

318 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.06 seconds

319 title;

320

321 title "Cox Proportion Hazards Model for Stroke";

322 proc phreg data=framingham;

323 where exam=1;

324 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

324! diabetes(ref="No Diabetes") / param=ref;

325 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi /

325! risklimits;

326 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.09 seconds

327 title;

328

329

330

331 ODS HTML close;

332 ODS HTML;

NOTE: Writing HTML Body file: sashtml2.htm

333

334

335

336 /\* Model B1: Total Cholesterol, Cigarette Category, Sex, Age, SBP, Diabetes, BMI \*/

337 title "Cox Proportion Hazards Model for CVD";

338 proc phreg data=framingham;

339 where exam=1;

340 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") /

340! param=ref;

341 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp diabetes bmi / risklimits;

342 run;

NOTE: 102 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.09 seconds

343 title;

344

345 title "Cox Proportion Hazards Model for CHD";

346 proc phreg data=framingham;

347 where exam=1;

348 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") /

348! param=ref;

349 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp diabetes bmi / risklimits;

350 run;

NOTE: 102 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.08 seconds

cpu time 0.09 seconds

351 title;

352

353 title "Cox Proportion Hazards Model for Stroke";

354 proc phreg data=framingham;

355 where exam=1;

356 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") /

356! param=ref;

357 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp diabetes bmi / risklimits;

358 run;

NOTE: 102 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

359 title;

360

361

362

363 /\* Model B2: Total Cholesterol, Cigarette Category, Sex, Age, BP\_Meds, Diabetes, BMI \*/

364 title "Cox Proportion Hazards Model for CVD";

365 proc phreg data=framingham;

366 where exam=1;

367 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

367! diabetes(ref="No Diabetes") / param=ref;

368 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age bp\_meds diabetes bmi / risklimits;

369 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.06 seconds

370 title;

371

372 title "Cox Proportion Hazards Model for CHD";

373 proc phreg data=framingham;

374 where exam=1;

375 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

375! diabetes(ref="No Diabetes") / param=ref;

376 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age bp\_meds diabetes bmi / risklimits;

377 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

378 title;

379

380 title "Cox Proportion Hazards Model for Stroke";

381 proc phreg data=framingham;

382 where exam=1;

383 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

383! diabetes(ref="No Diabetes") / param=ref;

384 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age bp\_meds diabetes bmi /

384! risklimits;

385 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

386 title;

387

388

389

390 /\* Model B3: Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds BMI \*/

391 title "Cox Proportion Hazards Model for CVD";

392 proc phreg data=framingham;

393 where exam=1;

394 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

394! diabetes(ref="No Diabetes") / param=ref;

395 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds bmi / risklimits;

396 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.09 seconds

397 title;

398

399 title "Cox Proportion Hazards Model for CHD";

400 proc phreg data=framingham;

401 where exam=1;

402 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") /

402! param=ref;

403 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds bmi / risklimits;

404 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.09 seconds

405 title;

406

407 title "Cox Proportion Hazards Model for Stroke";

408 proc phreg data=framingham;

409 where exam=1;

410 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") /

410! param=ref;

411 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds bmi / risklimits;

412 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

413 title;

414

415

416

417 /\* Model B4: Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds, Diabetes \*/

418 title "Cox Proportion Hazards Model for CVD";

419 proc phreg data=framingham;

420 where exam=1;

421 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

421! diabetes(ref="No Diabetes") / param=ref;

422 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes / risklimits;

423 run;

NOTE: 143 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.04 seconds

424 title;

425

426 title "Cox Proportion Hazards Model for CHD";

427 proc phreg data=framingham;

428 where exam=1;

429 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

429! diabetes(ref="No Diabetes") / param=ref;

430 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes / risklimits;

431 run;

NOTE: 143 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.12 seconds

cpu time 0.07 seconds

432 title;

433

434 title "Cox Proportion Hazards Model for Stroke";

435 proc phreg data=framingham;

436 where exam=1;

437 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

437! diabetes(ref="No Diabetes") / param=ref;

438 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes /

438! risklimits;

439 run;

NOTE: 143 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.10 seconds

440 title;

441

442

443

444 /\* Model B5: Total Cholesterol, Cigarette Category, Sex, Age, SBP, BP\_Meds \*/

445 title "Cox Proportion Hazards Model for CVD";

446 proc phreg data=framingham;

447 where exam=1;

448 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") /

448! param=ref;

449 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds / risklimits;

450 run;

NOTE: 143 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.06 seconds

451 title;

452

453 title "Cox Proportion Hazards Model for CHD";

454 proc phreg data=framingham;

455 where exam=1;

456 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") /

456! param=ref;

457 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds / risklimits;

458 run;

NOTE: 143 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.06 seconds

459 title;

460

461 title "Cox Proportion Hazards Model for Stroke";

462 proc phreg data=framingham;

463 where exam=1;

464 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") /

464! param=ref;

465 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds / risklimits;

466 run;

NOTE: 143 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.09 seconds

467 title;

468

469

470

471 /\* Model B6: Total Cholesterol, Cigarette Category, Sex, Age, SBP \*/

472 title "Cox Proportion Hazards Model for CVD";

473 proc phreg data=framingham;

474 where exam=1;

475 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

476 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp / risklimits;

477 run;

NOTE: 84 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.04 seconds

478 title;

479

480 title "Cox Proportion Hazards Model for CHD";

481 proc phreg data=framingham;

482 where exam=1;

483 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

484 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp / risklimits;

485 run;

NOTE: 84 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.04 seconds

486 title;

487

488 title "Cox Proportion Hazards Model for Stroke";

489 proc phreg data=framingham;

490 where exam=1;

491 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

492 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp / risklimits;

493 run;

NOTE: 84 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

494 title;

495

496

497

498 /\* Model B7: Total Cholesterol, Cigarette Category, Sex, Age, BP\_Meds \*/

499 title "Cox Proportion Hazards Model for CVD";

500 proc phreg data=framingham;

501 where exam=1;

502 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") /

502! param=ref;

503 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age bp\_meds / risklimits;

504 run;

NOTE: 143 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

505 title;

506

507 title "Cox Proportion Hazards Model for CHD";

508 proc phreg data=framingham;

509 where exam=1;

510 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") /

510! param=ref;

511 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age bp\_meds / risklimits;

512 run;

NOTE: 143 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

513 title;

514

515 title "Cox Proportion Hazards Model for stroke";

516 proc phreg data=framingham;

517 where exam=1;

518 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds") /

518! param=ref;

519 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age bp\_meds / risklimits;

520 run;

NOTE: 143 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

521 title;

522

523

524

525 /\* Model B8: Total Cholesterol, Cigarette Category, Sex, Age, Diabetes, BMI \*/

526 title "Cox Proportion Hazards Model for CVD";

527 proc phreg data=framingham;

528 where exam=1;

529 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") /

529! param=ref;

530 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age diabetes bmi / risklimits;

531 run;

NOTE: 102 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.09 seconds

532 title;

533

534 title "Cox Proportion Hazards Model for CHD";

535 proc phreg data=framingham;

536 where exam=1;

537 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") /

537! param=ref;

538 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age diabetes bmi / risklimits;

539 run;

NOTE: 102 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.06 seconds

540 title;

541

542 title "Cox Proportion Hazards Model for Stroke";

543 proc phreg data=framingham;

544 where exam=1;

545 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") /

545! param=ref;

546 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age diabetes bmi / risklimits;

547 run;

NOTE: 102 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

548 title;

549

550

551

552 /\* Model B9: Total Cholesterol, Cigarette Category, Sex, Age, Diabetes \*/

553 title "Cox Proportion Hazards Model for CVD";

554 proc phreg data=framingham;

555 where exam=1;

556 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") /

556! param=ref;

557 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age diabetes / risklimits;

558 run;

NOTE: 84 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

559 title;

560

561 title "Cox Proportion Hazards Model for CHD";

562 proc phreg data=framingham;

563 where exam=1;

564 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") /

564! param=ref;

565 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age diabetes / risklimits;

566 run;

NOTE: 84 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.09 seconds

567 title;

568

569 title "Cox Proportion Hazards Model for Stroke";

570 proc phreg data=framingham;

571 where exam=1;

572 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") diabetes(ref="No Diabetes") /

572! param=ref;

573 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age diabetes / risklimits;

574 run;

NOTE: 84 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.08 seconds

cpu time 0.07 seconds

575 title;

576

577

578

579 /\* Model B10: Total Cholesterol, Cigarette Category, Sex, Age, BMI \*/

580 title "Cox Proportion Hazards Model for CVD";

581 proc phreg data=framingham;

582 where exam=1;

583 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

584 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age bmi / risklimits;

585 run;

NOTE: 102 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.06 seconds

586 title;

587

588 title "Cox Proportion Hazards Model for CHD";

589 proc phreg data=framingham;

590 where exam=1;

591 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

592 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age bmi / risklimits;

593 run;

NOTE: 102 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.07 seconds

cpu time 0.06 seconds

594 title;

595

596 title "Cox Proportion Hazards Model for Stroke";

597 proc phreg data=framingham;

598 where exam=1;

599 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

600 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age bmi / risklimits;

601 run;

NOTE: 102 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.08 seconds

cpu time 0.06 seconds

602 title;

603

604

605

606 /\* Model B11: Total Cholesterol, Cigarette Category, Sex, Age \*/

607 title "Cox Proportion Hazards Model for CVD";

608 proc phreg data=framingham;

609 where exam=1;

610 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

611 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age / risklimits;

612 run;

NOTE: 84 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.08 seconds

cpu time 0.07 seconds

613 title;

614

615 title "Cox Proportion Hazards Model for CHD";

616 proc phreg data=framingham;

617 where exam=1;

618 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

619 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age / risklimits;

620 run;

NOTE: 84 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.08 seconds

cpu time 0.09 seconds

621 title;

622

623 title "Cox Proportion Hazards Model for Stroke";

624 proc phreg data=framingham;

625 where exam=1;

626 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") / param=ref;

627 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age / risklimits;

628 run;

NOTE: 84 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.04 seconds

629 title;

630

631

632

633 ODS HTML close;

634 ODS HTML;

NOTE: Writing HTML Body file: sashtml3.htm

635

636

637

638 /\* Model C: Logarithmically Transformed Continuous Variables \*/

639 title "Cox Proportion Hazards Model for CVD";

640 proc phreg data=framingham;

641 where exam=1;

642 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

642! diabetes(ref="No Diabetes") / param=ref;

643 model time\_cvd\*cvd(0) = log\_chol cigarette\_cat sex log\_age log\_sbp bp\_meds diabetes log\_bmi /

643! risklimits;

644 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

645 title;

646

647 title "Cox Proportion Hazards Model for CHD";

648 proc phreg data=framingham;

649 where exam=1;

650 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

650! diabetes(ref="No Diabetes") / param=ref;

651 model time\_chd\*chd(0) = log\_chol cigarette\_cat sex log\_age log\_sbp bp\_meds diabetes log\_bmi /

651! risklimits;

652 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

653 title;

654

655 title "Cox Proportion Hazards Model for Stroke";

656 proc phreg data=framingham;

657 where exam=1;

658 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

658! diabetes(ref="No Diabetes") / param=ref;

659 model time\_stroke\*stroke(0) = log\_chol cigarette\_cat sex log\_age log\_sbp bp\_meds diabetes

659! log\_bmi / risklimits;

660 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.04 seconds

661 title;

662

663

664

665 ODS HTML close;

666 ODS HTML;

NOTE: Writing HTML Body file: sashtml4.htm

667

668

669

670 /\* Model D1: Interaction Between Total Cholesterol and Age \*/

671 title "Cox Proportion Hazards Model for CVD";

672 proc phreg data=framingham;

673 where exam=1;

674 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

674! diabetes(ref="No Diabetes") / param=ref;

675 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

675! total\_chol\*age / risklimits;

676 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.11 seconds

677 title;

678

679 title "Cox Proportion Hazards Model for CHD";

680 proc phreg data=framingham;

681 where exam=1;

682 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

682! diabetes(ref="No Diabetes") / param=ref;

683 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

683! total\_chol\*age / risklimits;

684 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.10 seconds

685 title;

686

687 title "Cox Proportion Hazards Model for Stroke";

688 proc phreg data=framingham;

689 where exam=1;

690 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

690! diabetes(ref="No Diabetes") / param=ref;

691 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

691! total\_chol\*age / risklimits;

692 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.11 seconds

cpu time 0.09 seconds

693 title;

694

695

696

697 /\* Model D2: Interaction Between Total Cholesterol and Sex \*/

698 title "Cox Proportion Hazards Model for CVD";

699 proc phreg data=framingham;

700 where exam=1;

701 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

701! diabetes(ref="No Diabetes") / param=ref;

702 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp diabetes bmi total\_chol\*sex /

702! risklimits;

703 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.10 seconds

704 title;

705

706 title "Cox Proportion Hazards Model for CHD";

707 proc phreg data=framingham;

708 where exam=1;

709 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

709! diabetes(ref="No Diabetes") / param=ref;

710 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

710! total\_chol\*sex / risklimits;

711 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

712 title;

713

714 title "Cox Proportion Hazards Model for Stroke";

715 proc phreg data=framingham;

716 where exam=1;

717 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

717! diabetes(ref="No Diabetes") / param=ref;

718 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

718! total\_chol\*sex / risklimits;

719 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

720 title;

721

722

723

724 /\* Model D3: Interaction Between Cigarette Category and Age \*/

725 title "Cox Proportion Hazards Model for CVD";

726 proc phreg data=framingham;

727 where exam=1;

728 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

728! diabetes(ref="No Diabetes") / param=ref;

729 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

729! cigarette\_cat\*age / risklimits;

730 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.09 seconds

731 title;

732

733 title "Cox Proportion Hazards Model for CHD";

734 proc phreg data=framingham;

735 where exam=1;

736 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

736! diabetes(ref="No Diabetes") / param=ref;

737 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

737! cigarette\_cat\*age / risklimits;

738 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.11 seconds

cpu time 0.07 seconds

739 title;

740

741 title "Cox Proportion Hazards Model for Stroke";

742 proc phreg data=framingham;

743 where exam=1;

744 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

744! diabetes(ref="No Diabetes") / param=ref;

745 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

745! cigarette\_cat\*age / risklimits;

746 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.12 seconds

cpu time 0.09 seconds

747 title;

748

749

750

751 /\* Model D4: Interaction Between Cigarette Category and Sex \*/

752 title "Cox Proportion Hazards Model for CVD";

753 proc phreg data=framingham;

754 where exam=1;

755 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

755! diabetes(ref="No Diabetes") / param=ref;

756 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

756! cigarette\_cat\*sex / risklimits;

757 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.09 seconds

758 title;

759

760 title "Cox Proportion Hazards Model for CHD";

761 proc phreg data=framingham;

762 where exam=1;

763 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

763! diabetes(ref="No Diabetes") / param=ref;

764 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

764! cigarette\_cat\*sex / risklimits;

765 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

766 title;

767

768 title "Cox Proportion Hazards Model for Stroke";

769 proc phreg data=framingham;

770 where exam=1;

771 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

771! diabetes(ref="No Diabetes") / param=ref;

772 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

772! cigarette\_cat\*sex / risklimits;

773 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.11 seconds

774 title;

775

776

777

778 /\* Model D5: Interaction Between SBP and Age \*/

779 title "Cox Proportion Hazards Model for CVD";

780 proc phreg data=framingham;

781 where exam=1;

782 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

782! diabetes(ref="No Diabetes") / param=ref;

783 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi sbp\*age /

783! risklimits;

784 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

785 title;

786

787 title "Cox Proportion Hazards Model for CHD";

788 proc phreg data=framingham;

789 where exam=1;

790 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

790! diabetes(ref="No Diabetes") / param=ref;

791 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi sbp\*age /

791! risklimits;

792 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

793 title;

794

795 title "Cox Proportion Hazards Model for Stroke";

796 proc phreg data=framingham;

797 where exam=1;

798 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

798! diabetes(ref="No Diabetes") / param=ref;

799 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

799! sbp\*age / risklimits;

800 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.11 seconds

cpu time 0.06 seconds

801 title;

802

803

804

805 /\* Model D6: Interaction Between SBP and Sex \*/

806 title "Cox Proportion Hazards Model for CVD";

807 proc phreg data=framingham;

808 where exam=1;

809 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

809! diabetes(ref="No Diabetes") / param=ref;

810 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi sbp\*sex /

810! risklimits;

811 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.10 seconds

812 title;

813

814 title "Cox Proportion Hazards Model for CHD";

815 proc phreg data=framingham;

816 where exam=1;

817 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

817! diabetes(ref="No Diabetes") / param=ref;

818 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi sbp\*sex /

818! risklimits;

819 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.12 seconds

cpu time 0.07 seconds

820 title;

821

822 title "Cox Proportion Hazards Model for Stroke";

823 proc phreg data=framingham;

824 where exam=1;

825 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

825! diabetes(ref="No Diabetes") / param=ref;

826 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

826! sbp\*sex / risklimits;

827 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.09 seconds

828 title;

829

830

831

832 /\* Model D7: Interaction Between Diabetes and Age \*/

833 title "Cox Proportion Hazards Model for CVD";

834 proc phreg data=framingham;

835 where exam=1;

836 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

836! diabetes(ref="No Diabetes") / param=ref;

837 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

837! diabetes\*age / risklimits;

838 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

839 title;

840

841 title "Cox Proportion Hazards Model for CHD";

842 proc phreg data=framingham;

843 where exam=1;

844 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

844! diabetes(ref="No Diabetes") / param=ref;

845 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

845! diabetes\*age / risklimits;

846 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

847 title;

848

849 title "Cox Proportion Hazards Model for Stroke";

850 proc phreg data=framingham;

851 where exam=1;

852 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

852! diabetes(ref="No Diabetes") / param=ref;

853 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

853! diabetes\*age / risklimits;

854 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.11 seconds

cpu time 0.10 seconds

855 title;

856

857

858

859 /\* Model D8: Interaction Between Diabetes and Sex \*/

860 title "Cox Proportion Hazards Model for CVD";

861 proc phreg data=framingham;

862 where exam=1;

863 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

863! diabetes(ref="No Diabetes") / param=ref;

864 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

864! diabetes\*sex / risklimits;

865 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

866 title;

867

868 title "Cox Proportion Hazards Model for CHD";

869 proc phreg data=framingham;

870 where exam=1;

871 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

871! diabetes(ref="No Diabetes") / param=ref;

872 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

872! diabetes\*sex / risklimits;

873 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.10 seconds

874 title;

875

876 title "Cox Proportion Hazards Model for Stroke";

877 proc phreg data=framingham;

878 where exam=1;

879 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

879! diabetes(ref="No Diabetes") / param=ref;

880 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

880! diabetes\*sex / risklimits;

881 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

882 title;

883

884

885

886 /\* Model D9: Interaction Between BMI and Age \*/

887 title "Cox Proportion Hazards Model for CVD";

888 proc phreg data=framingham;

889 where exam=1;

890 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

890! diabetes(ref="No Diabetes") / param=ref;

891 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*age /

891! risklimits;

892 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

893 title;

894

895 title "Cox Proportion Hazards Model for CHD";

896 proc phreg data=framingham;

897 where exam=1;

898 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

898! diabetes(ref="No Diabetes") / param=ref;

899 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*age /

899! risklimits;

900 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.09 seconds

901 title;

902

903 title "Cox Proportion Hazards Model for Stroke";

904 proc phreg data=framingham;

905 where exam=1;

906 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

906! diabetes(ref="No Diabetes") / param=ref;

907 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

907! bmi\*age / risklimits;

908 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.07 seconds

909 title;

910

911

912

913 /\* Model D10: Interaction Between Diabetes and Sex \*/

914 title "Cox Proportion Hazards Model for CVD";

915 proc phreg data=framingham;

916 where exam=1;

917 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

917! diabetes(ref="No Diabetes") / param=ref;

918 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*sex /

918! risklimits;

919 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

920 title;

921

922 title "Cox Proportion Hazards Model for CHD";

923 proc phreg data=framingham;

924 where exam=1;

925 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

925! diabetes(ref="No Diabetes") / param=ref;

926 model time\_chd\*chd(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*sex /

926! risklimits;

927 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.09 seconds

928 title;

929

930 title "Cox Proportion Hazards Model for Stroke";

931 proc phreg data=framingham;

932 where exam=1;

933 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

933! diabetes(ref="No Diabetes") / param=ref;

934 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat sex age sbp bp\_meds diabetes bmi

934! bmi\*sex / risklimits;

935 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.10 seconds

cpu time 0.09 seconds

936 title;

937

938

939

940 /\* Model D11: Interaction Between Total Cholesterol and Cigarette Category\*/

941 title "Cox Proportion Hazards Model for CVD";

942 proc phreg data=framingham;

943 where exam=1;

944 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

944! diabetes(ref="No Diabetes") / param=ref;

945 model time\_cvd\*cvd(0) = total\_chol | cigarette\_cat sex age sbp bp\_meds diabetes bmi /

945! risklimits;

946 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.11 seconds

cpu time 0.06 seconds

947 title;

948

949 title "Cox Proportion Hazards Model for CHD";

950 proc phreg data=framingham;

951 where exam=1;

952 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

952! diabetes(ref="No Diabetes") / param=ref;

953 model time\_chd\*chd(0) = total\_chol | cigarette\_cat sex age sbp bp\_meds diabetes bmi bmi\*sex /

953! risklimits;

954 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.11 seconds

cpu time 0.07 seconds

955 title;

956

957 title "Cox Proportion Hazards Model for Stroke";

958 proc phreg data=framingham;

959 where exam=1;

960 class cigarette\_cat(ref="0 Cigarettes") sex(ref="Female") bp\_meds(ref="No BP Meds")

960! diabetes(ref="No Diabetes") / param=ref;

961 model time\_stroke\*stroke(0) = total\_chol | cigarette\_cat sex age sbp bp\_meds diabetes bmi

961! bmi\*sex / risklimits;

962 run;

NOTE: 161 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint

test for an effect is a test that all of the parameters associated with that effect are zero.

Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

NOTE: Hazard ratios that cannot be conveniently calculated or displayed are set to missing in the

ParameterEstimates table. Use the HAZARDRATIO statement to compute the needed hazard ratios.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.11 seconds

cpu time 0.09 seconds

963 title;

964

965

966

967 ODS HTML close;

968 ODS HTML;

NOTE: Writing HTML Body file: sashtml5.htm

969

970

971

972 /\* Model Cox Proportional Hazards for Males \*/

973 title "Cox Proportion Hazards Model for CVD among Males";

974 proc phreg data=framingham;

975 where exam=1 and sex=1;

976 class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes")

976! / param=ref;

977 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi / risklimits;

978 run;

NOTE: 49 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

979 title;

980

981 title "Cox Proportion Hazards Model for CHD among Males";

982 proc phreg data=framingham;

983 where exam=1 and sex=1;

984 class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes")

984! / param=ref;

985 model time\_chd\*chd(0) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi / risklimits;

986 run;

NOTE: 49 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.08 seconds

cpu time 0.07 seconds

987 title;

988

989 title "Cox Proportion Hazards Model for Stroke among Males";

990 proc phreg data=framingham;

991 where exam=1 and sex=1;

992 class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No Diabetes")

992! / param=ref;

993 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi /

993! risklimits;

994 run;

NOTE: 49 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.08 seconds

cpu time 0.07 seconds

995 title;

996

997

998

999 /\* Cox Proportional Hazards for Females \*/

1000 title "Cox Proportion Hazards Model for CVD among Females";

1001 proc phreg data=framingham;

1002 where exam=1 and sex=2;

1003 class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No

1003! Diabetes") / param=ref;

1004 model time\_cvd\*cvd(0) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi / risklimits;

1005 run;

NOTE: 112 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.09 seconds

cpu time 0.07 seconds

1006 title;

1007

1008 title "Cox Proportion Hazards Model for CHD among Females";

1009 proc phreg data=framingham;

1010 where exam=1 and sex=2;

1011 class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No

1011! Diabetes") / param=ref;

1012 model time\_chd\*chd(0) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi / risklimits;

1013 run;

NOTE: 112 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.08 seconds

cpu time 0.04 seconds

1014 title;

1015

1016 title "Cox Proportion Hazards Model for Stroke among Females";

1017 proc phreg data=framingham;

1018 where exam=1 and sex=2;

1019 class cigarette\_cat(ref="0 Cigarettes") bp\_meds(ref="No BP Meds") diabetes(ref="No

1019! Diabetes") / param=ref;

1020 model time\_stroke\*stroke(0) = total\_chol cigarette\_cat age sbp bp\_meds diabetes bmi /

1020! risklimits;

1021 run;

NOTE: 112 observations were deleted due either to missing or invalid values for the time, censoring,

frequency or explanatory variables or to invalid operations in generating the values for some

of the explanatory variables.

NOTE: Convergence criterion (GCONV=1E-8) satisfied.

NOTE: PROCEDURE PHREG used (Total process time):

real time 0.08 seconds

cpu time 0.09 seconds

1022 title;

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