Name Jenny

Student Number

STA 312 f2023 Quiz 11

1. (3 points) Consider a proportional hazards regression with two explanatory variables: a quantitative variable x, and actual time t.

   (a) Write the hazard function.

   $h(x) = h_0(t)\, e^{\beta_1 x + \beta_2 t}$

   (b) What happens to $e^{\beta_2 t}$?

   $= h_0(t)\, e^{\beta_2 t} \times e^{\beta_1 x}$

   It is swallowed into the baseline hazard function

2. (2 points) For the Area 51 data, you tested the effect of wearing a hat on the chances of being kidnapped by aliens. Fill in the table below. On your printout, circle the test statistic and p-value, and write "Question 2" beside them.

Chi-squared or Z Statistic	p-value	Reject H_0 at $\alpha = 0.05$? (Yes or No)
$Z = -2.761$	$p = 0.00576$	Yes

3. (2 points) In plain, non-statistical language, what do you conclude from the test above?

   Wearing a hat reduces the chances of being kidnapped by aliens (at least in Area 51).

4. (3 points) For the `channing` data (survival in nursing homes), you plotted the estimated survival curves for male and female nursing home residents. Please attach the plot, and the code that produced it. Write "Question 4" beside the code.

Please attach *both* printouts. Make sure your name is on them.

```
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[R.app GUI 1.79 (8198) x86_64-apple-darwin17.0]

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> # Q2: channing
> rm(list=ls()); # options(scipen=999)
> # install.packages("KMsurv",dependencies=TRUE) # Only need to do this once
> library(KMsurv); library(survival)
> data(channing) # For some reason this is necessary
>
> # We want age at entry. Age at censoring or death is the response variable
>
> retired = within(channing,
+ {
+ ageentry = ageentry/12 # Age in years
+ cageentry = (ageentry-mean(ageentry)) # Centered ageentry in years
+ gender = gender-1 # 1=F, 0=M
+ })
> summary(retired) # Q2a
      obs            death          ageentry          age            time
 Min.   :  1.0   Min.   :0.000   Min.   :61.08   Min.   : 777   Min.   :  0.00
 1st Qu.:116.2   1st Qu.:0.000   1st Qu.:71.17   1st Qu.: 939   1st Qu.: 35.00
 Median :231.5   Median :0.000   Median :75.00   Median : 990   Median : 81.50
 Mean   :231.5   Mean   :0.381   Mean   :75.47   Mean   : 986   Mean   : 80.12
 3rd Qu.:346.8   3rd Qu.:1.000   3rd Qu.:79.65   3rd Qu.:1031   3rd Qu.:137.00
 Max.   :462.0   Max.   :1.000   Max.   :95.00   Max.   :1207   Max.   :137.00
     gender       cageentry
 Min.   :0.00   Min.   :-14.3885
 1st Qu.:1.00   1st Qu.: -4.3052
 Median :1.00   Median : -0.4719
 Mean   :0.79   Mean   :  0.0000
 3rd Qu.:1.00   3rd Qu.:  4.1740
 Max.   :1.00   Max.   : 19.5281
>
> # 2b: False. It would be a male of average age.
>
```

```
> # 2b: (i) - (vi)
> mod = coxph( Surv(time,death) ~ cageentry + gender, data=retired); summary(mod)
Call:
coxph(formula = Surv(time, death) ~ cageentry + gender, data = retired)

  n= 462, number of events= 176

              coef exp(coef) se(coef)      z Pr(>|z|)
cageentry  0.08549   1.08925  0.01259  6.790 1.12e-11 ***
gender    -0.37591   0.68666  0.17191 -2.187   0.0288 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

          exp(coef) exp(-coef) lower .95 upper .95
cageentry    1.0892     0.9181    1.0627    1.1165
gender       0.6867     1.4563    0.4902    0.9618

Concordance= 0.647  (se = 0.023 )
Likelihood ratio test= 49.48  on 2 df,   p=2e-11
Wald test            = 51.51  on 2 df,   p=7e-12
Score (logrank) test = 52.6  on 2 df,   p=4e-12

> summary(mod)
Call:
coxph(formula = Surv(time, death) ~ cageentry + gender, data = retired)

  n= 462, number of events= 176

              coef exp(coef) se(coef)      z Pr(>|z|)
cageentry  0.08549   1.08925  0.01259  6.790 1.12e-11 ***
gender    -0.37591   0.68666  0.17191 -2.187   0.0288 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

          exp(coef) exp(-coef) lower .95 upper .95
cageentry    1.0892     0.9181    1.0627    1.1165
gender       0.6867     1.4563    0.4902    0.9618

Concordance= 0.647  (se = 0.023 )
Likelihood ratio test= 49.48  on 2 df,   p=2e-11
Wald test            = 51.51  on 2 df,   p=7e-12
Score (logrank) test = 52.6  on 2 df,   p=4e-12

>
> # 2b(vii)
> summary(coxph( Surv(time,death) ~ ageentry + gender, data=channing) )
Call:
coxph(formula = Surv(time, death) ~ ageentry + gender, data = channing)

  n= 462, number of events= 176

              coef exp(coef)  se(coef)      z Pr(>|z|)
ageentry  0.007124  1.007149  0.001049  6.790 1.12e-11 ***
gender   -0.375915  0.686661  0.171907 -2.187   0.0288 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

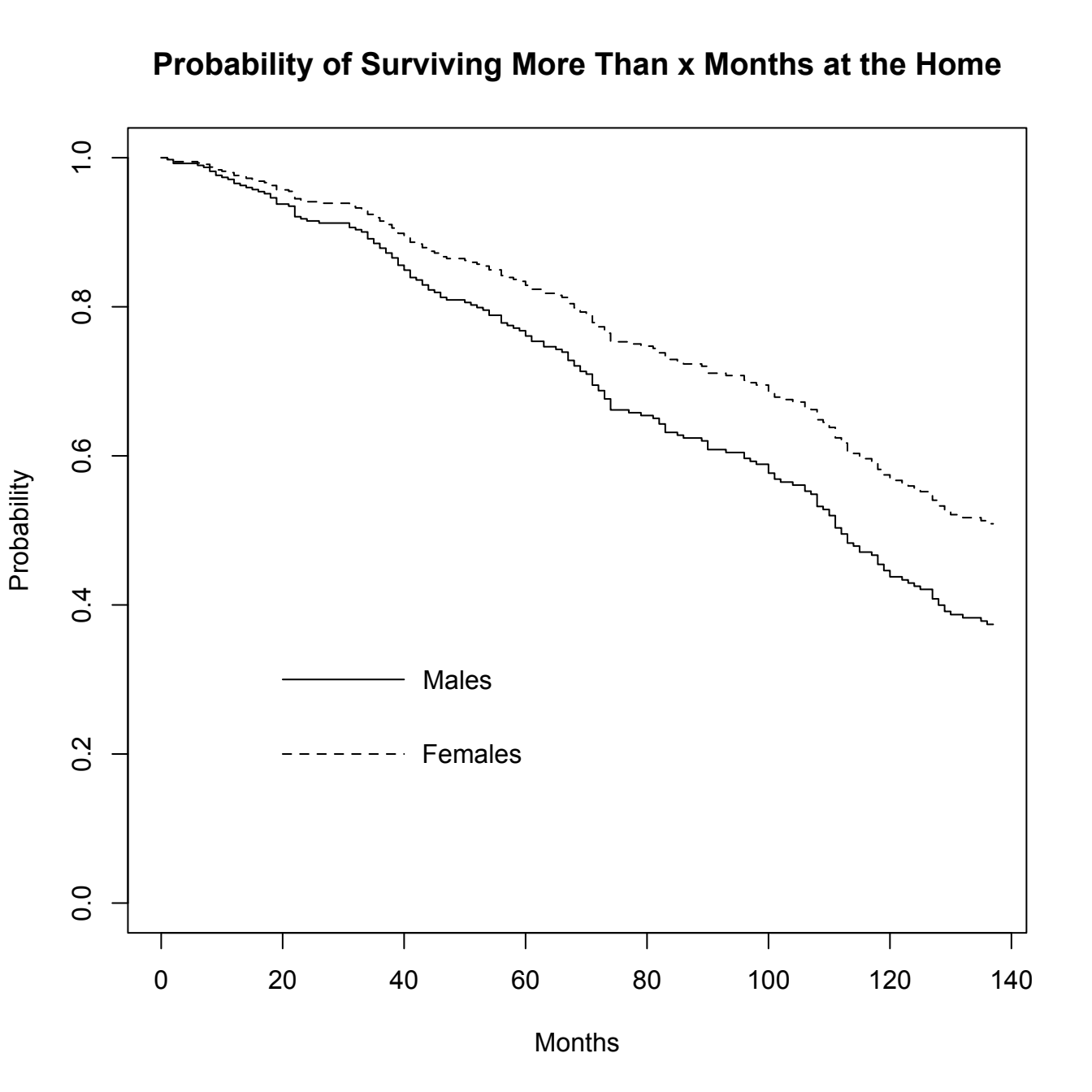
```
         exp(coef) exp(-coef) lower .95 upper .95
ageentry    1.0071     0.9929    1.0051    1.0092
gender      0.6867     1.4563    0.4902    0.9618

Concordance= 0.647  (se = 0.023 )
Likelihood ratio test= 49.48  on 2 df,   p=2e-11
Wald test            = 51.51  on 2 df,   p=7e-12
Score (logrank) test = 52.6  on 2 df,   p=4e-12

>
>
> # 2b(viii)
> # Just like in PH2 with R
> guy = data.frame(cageentry=0, gender=0); gal = data.frame(cageentry=0, gender=1)
> sexcomp = rbind(guy,gal); rownames(sexcomp) = c("M","F"); sexcomp
  cageentry gender
M         0      0
F         0      1
> s = survfit(mod,newdata=sexcomp); s
Call: survfit(formula = mod, newdata = sexcomp)

    n events median 0.95LCL 0.95UCL
M 462    176    112      98      NA
F 462    176     NA     124      NA
>
>
> # Make a nice plot
> plot(s,lty = c(1,2),xlab="Months", ylab="Probability")
> title('Probability of Surviving More Than x Months at the Home')
> xm = c(20,40); ym = c(0.3,0.3); lines(xm,ym,lty=1)
> text(50,0.3,"Males  ")
> xf = c(20,40); yf = c(0.2,0.2); lines(xf,yf,lty=2)
> text(50,0.2,"  Females")
>
>
```

Question 4


Probability of Surviving More Than x Months at the Home
Probability
0.0
0.2
0.4
0.6
0.8
1.0
Males
Females
0
20
40
60
80
100
120
140
Months

```
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> #Q4: Area 51
>
> library(survival)
> area51 = read.table("https://www.utstat.toronto.edu/brunner/data/legal/area51.data.txt")
> alien = coxph(Surv(time1,time2,taken) ~ age + sex + hat, data=area51)
> summary(alien)
Call:
coxph(formula = Surv(time1, time2, taken) ~ age + sex + hat,
    data = area51)

  n= 4244, number of events= 103

         coef exp(coef) se(coef)      z Pr(>|z|)
age  -0.00068   0.99932  0.01020 -0.067  0.94683
sexM  0.15126   1.16330  0.19811  0.764  0.44515
hat  -0.56542   0.56812  0.20478 -2.761  0.00576 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

     exp(coef) exp(-coef) lower .95 upper .95
age     0.9993     1.0007    0.9795    1.0195
sexM    1.1633     0.8596    0.7890    1.7152
hat     0.5681     1.7602    0.3803    0.8487

Concordance= 0.591  (se = 0.028 )
Likelihood ratio test= 8.48  on 3 df,   p=0.04
Wald test            = 8.2  on 3 df,   p=0.04
Score (logrank) test = 8.4  on 3 df,   p=0.04

>
>
```

Question 2