HW9

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library(survival)   
data.cancer<-cancer   
colnames(data.cancer)

## [1] "inst" "time" "status" "age" "sex"   
## [6] "ph.ecog" "ph.karno" "pat.karno" "meal.cal" "wt.loss"

fit <- survfit(Surv(time, status)~sex, data=data.cancer,type="kaplan-meier")   
summary(fit)

## Call: survfit(formula = Surv(time, status) ~ sex, data = data.cancer,   
## type = "kaplan-meier")  
##   
## sex=1   
## time n.risk n.event survival std.err lower 95% CI upper 95% CI  
## 11 138 3 0.9783 0.0124 0.9542 1.000  
## 12 135 1 0.9710 0.0143 0.9434 0.999  
## 13 134 2 0.9565 0.0174 0.9231 0.991  
## 15 132 1 0.9493 0.0187 0.9134 0.987  
## 26 131 1 0.9420 0.0199 0.9038 0.982  
## 30 130 1 0.9348 0.0210 0.8945 0.977  
## 31 129 1 0.9275 0.0221 0.8853 0.972  
## 53 128 2 0.9130 0.0240 0.8672 0.961  
## 54 126 1 0.9058 0.0249 0.8583 0.956  
## 59 125 1 0.8986 0.0257 0.8496 0.950  
## 60 124 1 0.8913 0.0265 0.8409 0.945  
## 65 123 2 0.8768 0.0280 0.8237 0.933  
## 71 121 1 0.8696 0.0287 0.8152 0.928  
## 81 120 1 0.8623 0.0293 0.8067 0.922  
## 88 119 2 0.8478 0.0306 0.7900 0.910  
## 92 117 1 0.8406 0.0312 0.7817 0.904  
## 93 116 1 0.8333 0.0317 0.7734 0.898  
## 95 115 1 0.8261 0.0323 0.7652 0.892  
## 105 114 1 0.8188 0.0328 0.7570 0.886  
## 107 113 1 0.8116 0.0333 0.7489 0.880  
## 110 112 1 0.8043 0.0338 0.7408 0.873  
## 116 111 1 0.7971 0.0342 0.7328 0.867  
## 118 110 1 0.7899 0.0347 0.7247 0.861  
## 131 109 1 0.7826 0.0351 0.7167 0.855  
## 132 108 2 0.7681 0.0359 0.7008 0.842  
## 135 106 1 0.7609 0.0363 0.6929 0.835  
## 142 105 1 0.7536 0.0367 0.6851 0.829  
## 144 104 1 0.7464 0.0370 0.6772 0.823  
## 147 103 1 0.7391 0.0374 0.6694 0.816  
## 156 102 2 0.7246 0.0380 0.6538 0.803  
## 163 100 3 0.7029 0.0389 0.6306 0.783  
## 166 97 1 0.6957 0.0392 0.6230 0.777  
## 170 96 1 0.6884 0.0394 0.6153 0.770  
## 175 94 1 0.6811 0.0397 0.6076 0.763  
## 176 93 1 0.6738 0.0399 0.5999 0.757  
## 177 92 1 0.6664 0.0402 0.5922 0.750  
## 179 91 2 0.6518 0.0406 0.5769 0.736  
## 180 89 1 0.6445 0.0408 0.5693 0.730  
## 181 88 2 0.6298 0.0412 0.5541 0.716  
## 183 86 1 0.6225 0.0413 0.5466 0.709  
## 189 83 1 0.6150 0.0415 0.5388 0.702  
## 197 80 1 0.6073 0.0417 0.5309 0.695  
## 202 78 1 0.5995 0.0419 0.5228 0.687  
## 207 77 1 0.5917 0.0420 0.5148 0.680  
## 210 76 1 0.5839 0.0422 0.5068 0.673  
## 212 75 1 0.5762 0.0424 0.4988 0.665  
## 218 74 1 0.5684 0.0425 0.4909 0.658  
## 222 72 1 0.5605 0.0426 0.4829 0.651  
## 223 70 1 0.5525 0.0428 0.4747 0.643  
## 229 67 1 0.5442 0.0429 0.4663 0.635  
## 230 66 1 0.5360 0.0431 0.4579 0.627  
## 239 64 1 0.5276 0.0432 0.4494 0.619  
## 246 63 1 0.5192 0.0433 0.4409 0.611  
## 267 61 1 0.5107 0.0434 0.4323 0.603  
## 269 60 1 0.5022 0.0435 0.4238 0.595  
## 270 59 1 0.4937 0.0436 0.4152 0.587  
## 283 57 1 0.4850 0.0437 0.4065 0.579  
## 284 56 1 0.4764 0.0438 0.3979 0.570  
## 285 54 1 0.4676 0.0438 0.3891 0.562  
## 286 53 1 0.4587 0.0439 0.3803 0.553  
## 288 52 1 0.4499 0.0439 0.3716 0.545  
## 291 51 1 0.4411 0.0439 0.3629 0.536  
## 301 48 1 0.4319 0.0440 0.3538 0.527  
## 303 46 1 0.4225 0.0440 0.3445 0.518  
## 306 44 1 0.4129 0.0440 0.3350 0.509  
## 310 43 1 0.4033 0.0441 0.3256 0.500  
## 320 42 1 0.3937 0.0440 0.3162 0.490  
## 329 41 1 0.3841 0.0440 0.3069 0.481  
## 337 40 1 0.3745 0.0439 0.2976 0.471  
## 353 39 2 0.3553 0.0437 0.2791 0.452  
## 363 37 1 0.3457 0.0436 0.2700 0.443  
## 364 36 1 0.3361 0.0434 0.2609 0.433  
## 371 35 1 0.3265 0.0432 0.2519 0.423  
## 387 34 1 0.3169 0.0430 0.2429 0.413  
## 390 33 1 0.3073 0.0428 0.2339 0.404  
## 394 32 1 0.2977 0.0425 0.2250 0.394  
## 428 29 1 0.2874 0.0423 0.2155 0.383  
## 429 28 1 0.2771 0.0420 0.2060 0.373  
## 442 27 1 0.2669 0.0417 0.1965 0.362  
## 455 25 1 0.2562 0.0413 0.1868 0.351  
## 457 24 1 0.2455 0.0410 0.1770 0.341  
## 460 22 1 0.2344 0.0406 0.1669 0.329  
## 477 21 1 0.2232 0.0402 0.1569 0.318  
## 519 20 1 0.2121 0.0397 0.1469 0.306  
## 524 19 1 0.2009 0.0391 0.1371 0.294  
## 533 18 1 0.1897 0.0385 0.1275 0.282  
## 558 17 1 0.1786 0.0378 0.1179 0.270  
## 567 16 1 0.1674 0.0371 0.1085 0.258  
## 574 15 1 0.1562 0.0362 0.0992 0.246  
## 583 14 1 0.1451 0.0353 0.0900 0.234  
## 613 13 1 0.1339 0.0343 0.0810 0.221  
## 624 12 1 0.1228 0.0332 0.0722 0.209  
## 643 11 1 0.1116 0.0320 0.0636 0.196  
## 655 10 1 0.1004 0.0307 0.0552 0.183  
## 689 9 1 0.0893 0.0293 0.0470 0.170  
## 707 8 1 0.0781 0.0276 0.0390 0.156  
## 791 7 1 0.0670 0.0259 0.0314 0.143  
## 814 5 1 0.0536 0.0239 0.0223 0.128  
## 883 3 1 0.0357 0.0216 0.0109 0.117  
##   
## sex=2   
## time n.risk n.event survival std.err lower 95% CI upper 95% CI  
## 5 90 1 0.9889 0.0110 0.9675 1.000  
## 60 89 1 0.9778 0.0155 0.9478 1.000  
## 61 88 1 0.9667 0.0189 0.9303 1.000  
## 62 87 1 0.9556 0.0217 0.9139 0.999  
## 79 86 1 0.9444 0.0241 0.8983 0.993  
## 81 85 1 0.9333 0.0263 0.8832 0.986  
## 95 83 1 0.9221 0.0283 0.8683 0.979  
## 107 81 1 0.9107 0.0301 0.8535 0.972  
## 122 80 1 0.8993 0.0318 0.8390 0.964  
## 145 79 2 0.8766 0.0349 0.8108 0.948  
## 153 77 1 0.8652 0.0362 0.7970 0.939  
## 166 76 1 0.8538 0.0375 0.7834 0.931  
## 167 75 1 0.8424 0.0387 0.7699 0.922  
## 182 71 1 0.8305 0.0399 0.7559 0.913  
## 186 70 1 0.8187 0.0411 0.7420 0.903  
## 194 68 1 0.8066 0.0422 0.7280 0.894  
## 199 67 1 0.7946 0.0432 0.7142 0.884  
## 201 66 2 0.7705 0.0452 0.6869 0.864  
## 208 62 1 0.7581 0.0461 0.6729 0.854  
## 226 59 1 0.7452 0.0471 0.6584 0.843  
## 239 57 1 0.7322 0.0480 0.6438 0.833  
## 245 54 1 0.7186 0.0490 0.6287 0.821  
## 268 51 1 0.7045 0.0501 0.6129 0.810  
## 285 47 1 0.6895 0.0512 0.5962 0.798  
## 293 45 1 0.6742 0.0523 0.5791 0.785  
## 305 43 1 0.6585 0.0534 0.5618 0.772  
## 310 42 1 0.6428 0.0544 0.5447 0.759  
## 340 39 1 0.6264 0.0554 0.5267 0.745  
## 345 38 1 0.6099 0.0563 0.5089 0.731  
## 348 37 1 0.5934 0.0572 0.4913 0.717  
## 350 36 1 0.5769 0.0579 0.4739 0.702  
## 351 35 1 0.5604 0.0586 0.4566 0.688  
## 361 33 1 0.5434 0.0592 0.4390 0.673  
## 363 32 1 0.5265 0.0597 0.4215 0.658  
## 371 30 1 0.5089 0.0603 0.4035 0.642  
## 426 26 1 0.4893 0.0610 0.3832 0.625  
## 433 25 1 0.4698 0.0617 0.3632 0.608  
## 444 24 1 0.4502 0.0621 0.3435 0.590  
## 450 23 1 0.4306 0.0624 0.3241 0.572  
## 473 22 1 0.4110 0.0626 0.3050 0.554  
## 520 19 1 0.3894 0.0629 0.2837 0.534  
## 524 18 1 0.3678 0.0630 0.2628 0.515  
## 550 15 1 0.3433 0.0634 0.2390 0.493  
## 641 11 1 0.3121 0.0649 0.2076 0.469  
## 654 10 1 0.2808 0.0655 0.1778 0.443  
## 687 9 1 0.2496 0.0652 0.1496 0.417  
## 705 8 1 0.2184 0.0641 0.1229 0.388  
## 728 7 1 0.1872 0.0621 0.0978 0.359  
## 731 6 1 0.1560 0.0590 0.0743 0.328  
## 735 5 1 0.1248 0.0549 0.0527 0.295  
## 765 3 1 0.0832 0.0499 0.0257 0.270

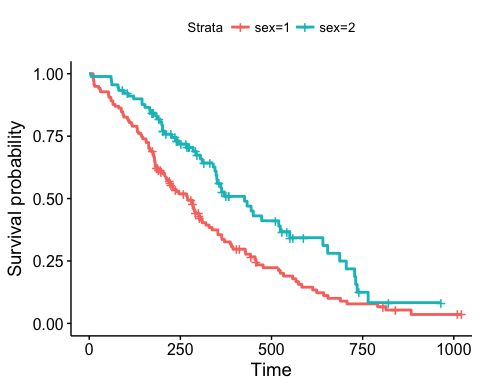
library(survminer)

## Loading required package: ggplot2

## Loading required package: ggpubr

## Loading required package: magrittr

ggsurvplot(fit)



fit

## Call: survfit(formula = Surv(time, status) ~ sex, data = data.cancer,   
## type = "kaplan-meier")  
##   
## n events median 0.95LCL 0.95UCL  
## sex=1 138 112 270 212 310  
## sex=2 90 53 426 348 550

***# the median for male is 270, for female is 426.***

# 2.Using a Cox proportional hazards model, estimate the hazard rate for Male relative to Female

cox<-coxph(Surv(time,status)~sex,data=data.cancer)  
summary(cox)

## Call:  
## coxph(formula = Surv(time, status) ~ sex, data = data.cancer)  
##   
## n= 228, number of events= 165   
##   
## coef exp(coef) se(coef) z Pr(>|z|)   
## sex -0.5310 0.5880 0.1672 -3.176 0.00149 \*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## exp(coef) exp(-coef) lower .95 upper .95  
## sex 0.588 1.701 0.4237 0.816  
##   
## Concordance= 0.579 (se = 0.022 )  
## Rsquare= 0.046 (max possible= 0.999 )  
## Likelihood ratio test= 10.63 on 1 df, p=0.001111  
## Wald test = 10.09 on 1 df, p=0.001491  
## Score (logrank) test = 10.33 on 1 df, p=0.001312

hazard.rate = exp( -0.5310)  
hazard.rate

## [1] 0.5880167

***# the hazard rate is 0.59***

# 3. Assess the validity of the proportional hazards assumption in (1)

test.ph <- cox.zph(cox)  
test.ph

## rho chisq p  
## sex 0.131 2.77 0.0962

***# Since the p-value is 0.0962, which is greater than 0.05, we reject the null hypothesis, and we can assume the proportional hazards.***

# 4.

cox.2<-coxph(Surv(time,status)~sex+age,data=data.cancer)  
summary(cox.2)

## Call:  
## coxph(formula = Surv(time, status) ~ sex + age, data = data.cancer)  
##   
## n= 228, number of events= 165   
##   
## coef exp(coef) se(coef) z Pr(>|z|)   
## sex -0.513219 0.598566 0.167458 -3.065 0.00218 \*\*  
## age 0.017045 1.017191 0.009223 1.848 0.06459 .   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## exp(coef) exp(-coef) lower .95 upper .95  
## sex 0.5986 1.6707 0.4311 0.8311  
## age 1.0172 0.9831 0.9990 1.0357  
##   
## Concordance= 0.603 (se = 0.026 )  
## Rsquare= 0.06 (max possible= 0.999 )  
## Likelihood ratio test= 14.12 on 2 df, p=0.0008574  
## Wald test = 13.47 on 2 df, p=0.001187  
## Score (logrank) test = 13.72 on 2 df, p=0.001048

hazard.rate2 = exp(-0.513219 )  
hazard.rate2

## [1] 0.5985657

***# the hazard rate after adjusting age is 0.5986***