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/* load data */
DATA data;
    INFILE "/home/u63563888/435/homework6/prostat.dat";
    INPUT patient_id treatment survival_time status
           age serum_haem tumour_size gleason_index;
RUN;

/* ***** */
/* COX-SNELL RESIDUALS */
/* ***** */

/* final model */
PROC PHREG DATA = data;
    CLASS treatment;
    MODEL survival_time*status(0) =
           tumour_size gleason_index treatment;
    OUTPUT OUT = cox_phreg LOGSURV = val_cox / METHOD = ch;
RUN;

DATA cox_data;
    SET cox_phreg;
    cox_resid = -val_cox;
RUN;

/* kaplan meier */
PROC LIFETEST DATA = cox_data METHOD = km OUTSURV = cox_km;
    TIME cox_resid * status(0);
RUN;

/* filter data */
DATA cox_filtered;
    SET cox_km;
    IF cox_resid = 0 or survival = 0 THEN delete;

    KEEP cox_resid survival;
RUN;

/* get cumulative hazard */
DATA cox_w_haz;
    SET cox_filtered;
    h = -log(survival);
    DROP survival;
RUN;

/* plot */
ods graphics on;
ods pdf file="/home/u63563888/435/homework6/hw6_cox_graph.pdf";

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goptions ROTATE=LANDSCAPE;
axis1 label=(h=2 f=swiss 'Cox-Snell Residual Value');
axis2 label=(h=2 f=swiss a=90 'Cumulative Hazard of Residual');
title 'Cox-Snell Residuals Plot';
PROC GPGLOT DATA = cox_w_haz;
    PLOT h*cox_resid h*h / overlay vaxis=axis2 haxis=axis1;
    symbol1 interpol=j h=1 l=2 v=square c=black;
    symbol2 interpol=j;
RUN;

ods pdf close;
ods graphics off;

/* ***** */
/* MARTINGALE RESIDUALS */
/* ***** */

/* final model */
PROC PHREG DATA = data;
    CLASS treatment;
    MODEL survival_time*status(0) =
        tumour_size gleason_index treatment;
    OUTPUT OUT = mart_phreg RESMART = val_mart;
RUN;

/* plots */
ods graphics on;
ods pdf file="/home/u63563888/435/homework6/hw6_mart_graph.pdf";

PROC SGPGLOT DATA = mart_phreg;
    LOESS Y=val_mart X=tumour_size;
    TITLE "Martingale Residual Plot for Tumour Size";
RUN;

PROC SGPGLOT DATA = mart_phreg;
    LOESS Y=val_mart X=gleason_index;
    TITLE "Martingale Residual Plot for Gleason Index";
RUN;

PROC SGPGLOT DATA = mart_phreg;
    LOESS Y=val_mart X=treatment;
    TITLE "Martingale Residual Plot for Treatment";
RUN;

ods pdf close;
ods graphics off;

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/* ***** */
/* SCHOENFELD RESIDUALS */
/* ***** */

/* final model */
PROC PHREG DATA = data;
    CLASS treatment;
    MODEL survival_time*status(0) =
        tumour_size gleason_index treatment;
    OUTPUT OUT = sch_phreg
        RESSCH = val_sch_tumour val_sch_gleason
val_sch_treat;
RUN;

/* kaplan meier for treatment (categorical) */
PROC LIFETEST DATA = data METHOD = km OUTSURV = sch_treat;
    TIME survival_time * status(0);
    TEST tumour_size gleason_index treatment;
RUN;

DATA sch_vals;
    SET sch_treat(KEEP = survival_time survival);
    logT = log(survival_time);
    logLogSurv = log(-log(survival));
RUN;

/* plot */
ods graphics on;
ods pdf file="/home/u63563888/435/homework6/hw6_sch_graph.pdf";

PROC SGPLOT DATA = sch_phreg;
    SCATTER Y=val_sch_tumour X=survival_time;
    REFLINE 0 / AXIS = y LINEATTRS = (COLOR = red PATTERN = dot);
    TITLE "Schoenfeld Residual Plot for Tumour Size";
RUN;

PROC SGPLOT DATA = sch_phreg;
    SCATTER Y=val_sch_gleason X=survival_time;
    REFLINE 0 / AXIS = y LINEATTRS = (COLOR = red PATTERN = dot);
    TITLE "Schoenfeld Residual Plot for Gleason Index";
RUN;

PROC SGPLOT DATA = sch_vals;
    SERIES x=survival_time y=logT;
    SERIES x=survival_time y=logLogSurv;
    TITLE "Schoenfeld Residual Plot for Treatment";

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        YAXIS LABEL="Value";
RUN;

ods pdf close;
ods graphics off;

/* ***** */
/* TABLE OF RESIDUALS */
/* ***** */

DATA residuals;
    MERGE cox_data (KEEP = patient_id cox_resid)
           mart_phreg (KEEP = patient_id val_mart)
           sch_phreg (KEEP = patient_id val_sch_tumour

                       val_sch_gleason

                       val_sch_treat);
    BY patient_id;
RUN;

ods pdf file="/home/u63563888/435/homework6/residual_data.pdf";
PROC PRINT DATA = residuals; RUN;
ods pdf close;

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