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Accelerated Failure Time

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Accelerated Failure Time

While in a proportional hazards model we modeled the effect of covariates on the hazard as a proportional multiplier of the baseline hazard:

$$h_{PH}(t) = hqqqa16_0(t)e^{\beta_1 X_1 + ... + \beta_n X_n},$$

in the accelerated failure time metric, the hazard becomes

$$h_{AFT}(t) = h_0(te^{-\beta_1 X_1 - ... - \beta_n X_n})e^{-\beta_1 X_1 - ... - \beta_n X_n}.$$

- The covariates place the subjects on different time scales.
- Because of the negative signs in the formula, a higher estimate will mean longer survival time.
- The estimates are now time ratios instead of hazard ratios.
  - how many times longer (shorter) do the subjects live compared to the reference category.

Exercise

Estimating the difference between survival times of laryngeal cancer patients at different stages of cancer.

stage	Stage of cancer (1 to 4)
delta	dead (1) or alive (0)
age	age at diagnosis
time	follow-up time (months)
diagyr	Year of diagnosis of larynx cancer

Exercise contd.

1. Open `larynx.dta`.
2. Look at some summaries of the data. What do you expect?
3. Set survival model with *time* as the duration and *delta* as the censoring variable.
4. Look at the survival curves stratified by stage and adjusted for age.
   - `sts graph strata(`*variable*`) adjustfor(`*variable*`)`
5. Run Cox regression with age and stage as covariates. Use the *i.* prefix to denote a categorical variable. E.g., *i.stage*.
6. Check the proportionality assumption.

Exercise contd.

7. Run a stratified Cox regression regarding stage.
8. Plot the baseline hazard to check what parametric shape might be reasonable.
9. Try accelerated failure time Weibull regression with age and stage as covariates and stage as categorical variable.
   - streg *age i.stage*, dist(weibull) time
   - the time option specifies that it should be run as an accelerated failure time regression.

Exercise - AFT Weibull regression

Weibull regression -- accelerated failure-time form

No. of subjects = 90
No. of failures = 50
Time at risk = 377.8000028

Log likelihood = -108.02675

Number of obs = 90
LR chi2(4) = 19.37
Prob > chi2 = 0.0007

Compared with the life time of a median stage 1 patient, the life time of a median stage 4 patient is exp(-1.54) = 0.21 shorter.

Or:

the median stage 1 patient lives 1/exp(-1.544) = 4.68 times longer.

_t	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	-.0174637	.0127784	-1.37	0.172	-.0425089	.0075815
stage						
2	-.1477042	.4075684	-0.36	0.717	-.9465235	.6511151
3	-.5865585	.3199497	-1.83	0.067	-1.213648	.0405315
4	-1.544076	.3632662	-4.25	0.000	-2.256065	-.8320874
_cons	3.52876	.9041232	3.90	0.000	1.756711	5.300809
/ln_p	.1223448	.1225052	1.00	0.318	-.1177609	.3624506
p	1.130144	.1384485			.8889085	1.436846
1/p	.8848432	.1083979			.6959687	1.124975

AFT - PH conversion

AFT and PH models can be easily converted into the other by

$$\beta_{AFT} = -\frac{\beta_{PH}}{p}$$

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if both model parameters are returned on the log scale.