



An example of competing risk analysis using STATA

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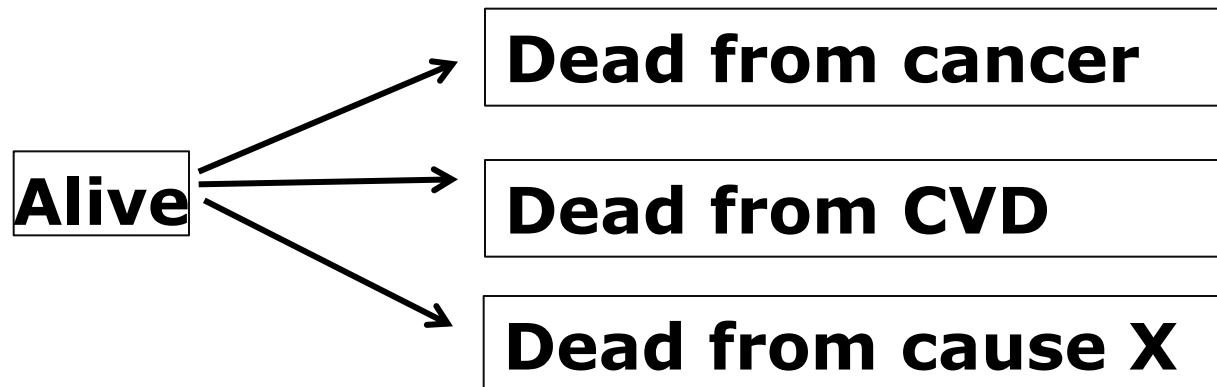
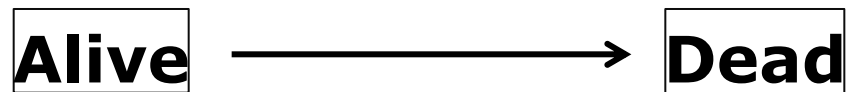
2011 Nordic and Baltic STATA users group meeting



What are competing risks?

Observations are $T > 0$ and failure type D

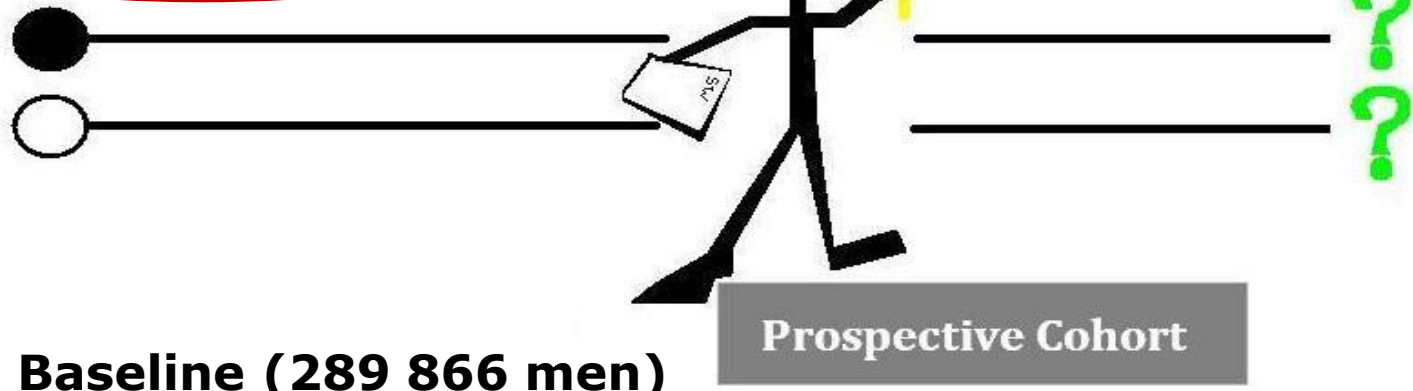
Survival analysis (event = dead)



Prospective cohort study

Exposure:

- BMI
- Blood pressure
- Glukose
- Cholesterol
- Triglycerides
- Metabolic syndrome score



Baseline (289 866 men)

- Mean age 44 year

Endpoints

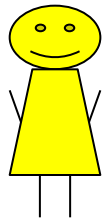
- 6 922 prostate cancer cases
- 1 016 deaths due to prostate cancer

Research questions

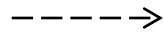
Association/Risk:

Metabolic factors /metabolic syndrome → Prostate cancer ?

- Could be answered with Cox (cause-specific hazard)



Prostate cancer diagnosis

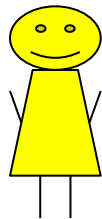


Censoring

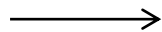
Real world scenario:

Metabolic factors/metabolic syndrome → prostate cancer?

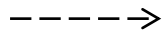
- Needs to be answered in a competing risk setting



Prostate cancer diagnosis



All-cause death



Censoring



What's the difference?

1. Elderly population

- Overestimation of absolute risk

2. The exposure, metabolic syndrome, is associated with early death

- "Bias" in relative risk

References:

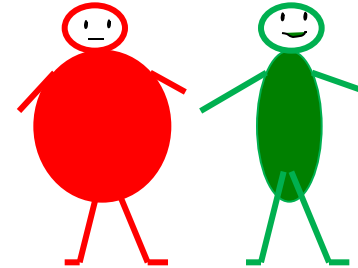
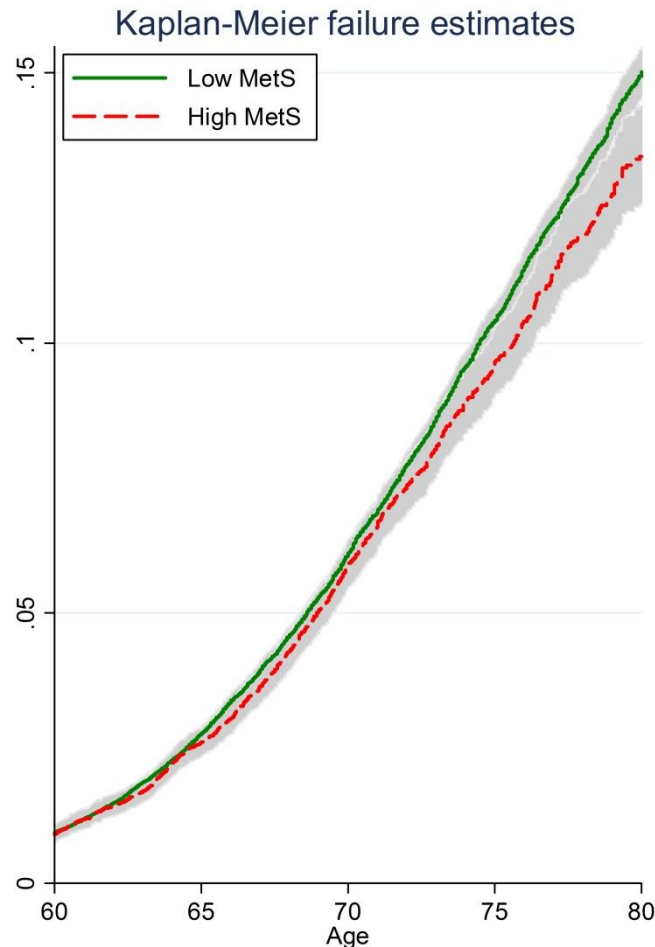
Berry SD, Ngo L, Samelson EJ, Kiel DP.

Competing Risk of Death: An Important Consideration in Studies of Older Adults.

Wolbers M, Koller MT, Witteman JC, Steyerberg EW.

Prognostic models with competing risks: methods and application to coronary risk prediction. *Epidemiology*. Jul 2009;20(4):555-561.

Cause-specific hazard: Kaplan-Meier estimates



```
stset dat_exit, fail(prostate==1) id(id) ///  
origin(dat_b) enter(dat_m_plusly) scale(365.25)  
  
sts graph, by(zero_mets) failure
```




Competing risk: Cumulative incidence

```
stset dat_exit, fail(risk_inc==1) id(id) ///  
origin(dat_b) enter(dat_m_plus1y) scale(365.25)
```

```
stcrreg zero_mets, compete(risk_inc==2)
```

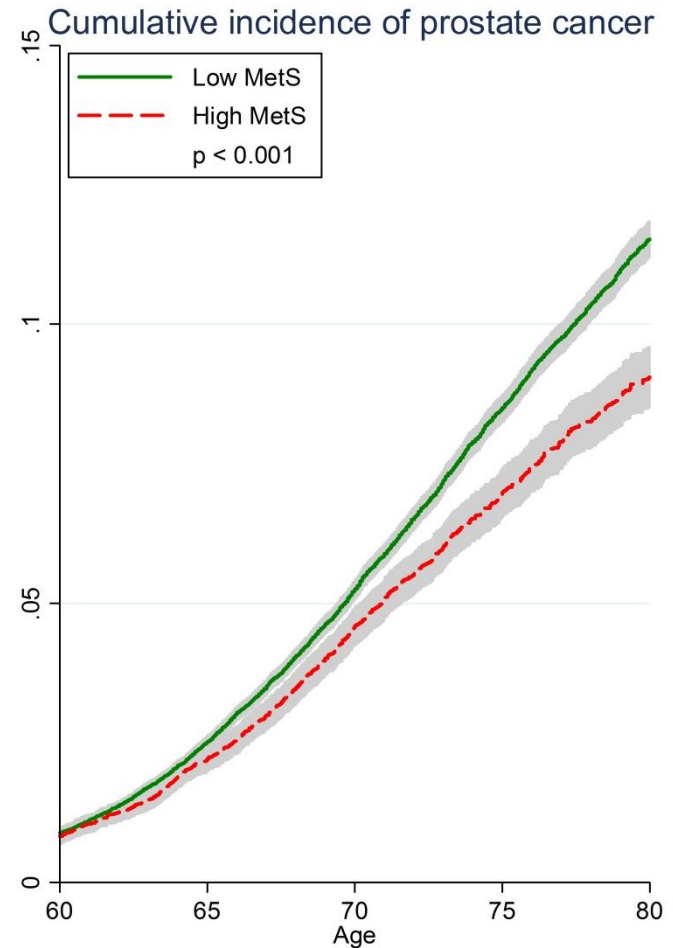
```
stcurve, cif at1(zero_mets=0) ///  
at2(zero_mets=1) range(60 80)
```

OR

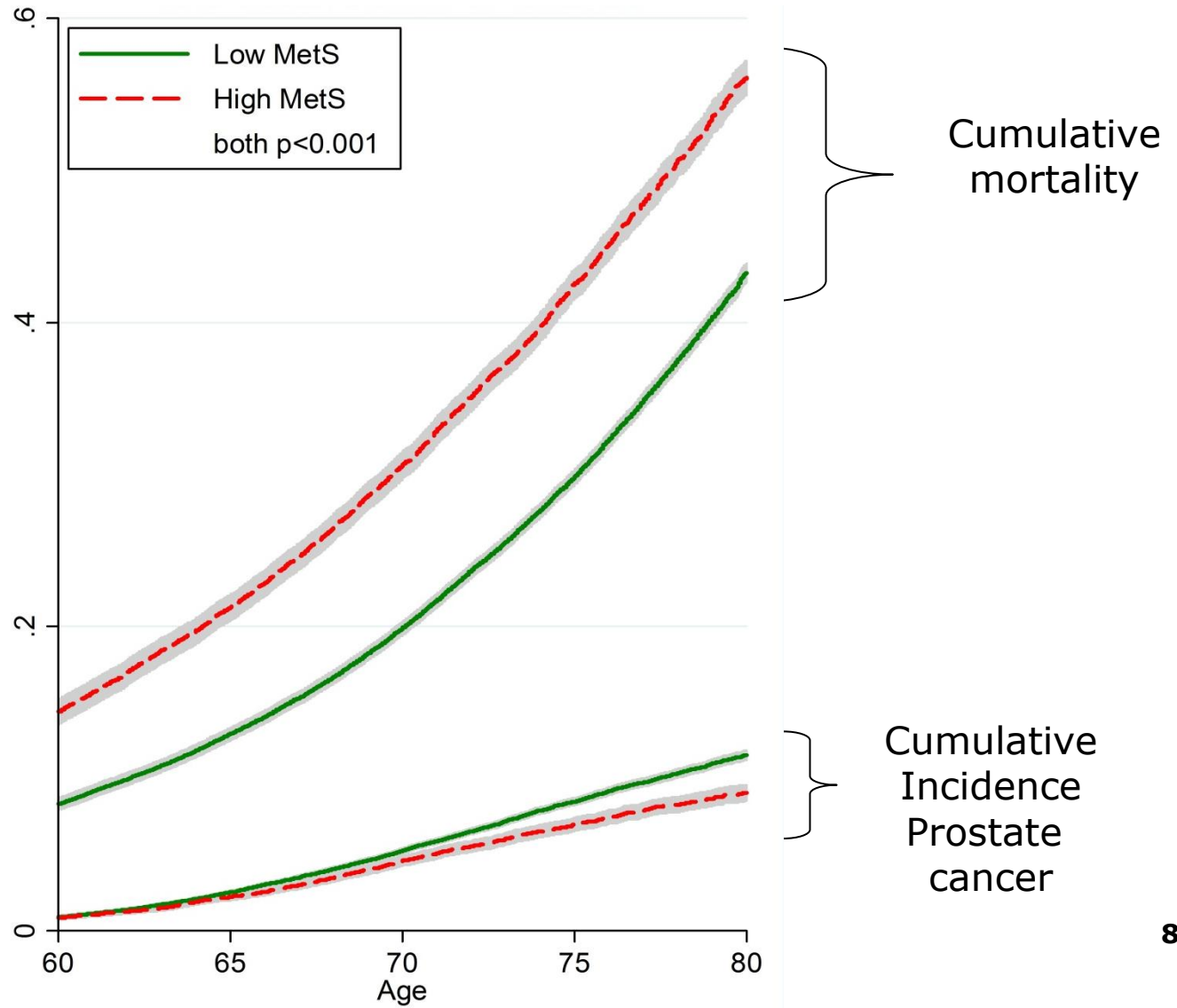
```
stcompet ci=ci, compet1(2) by (zero_mets)  
....  
tway line CI_0_pc CI_1_pc time
```

P-values from:

```
stpepemory zero_mets, compet(2)
```

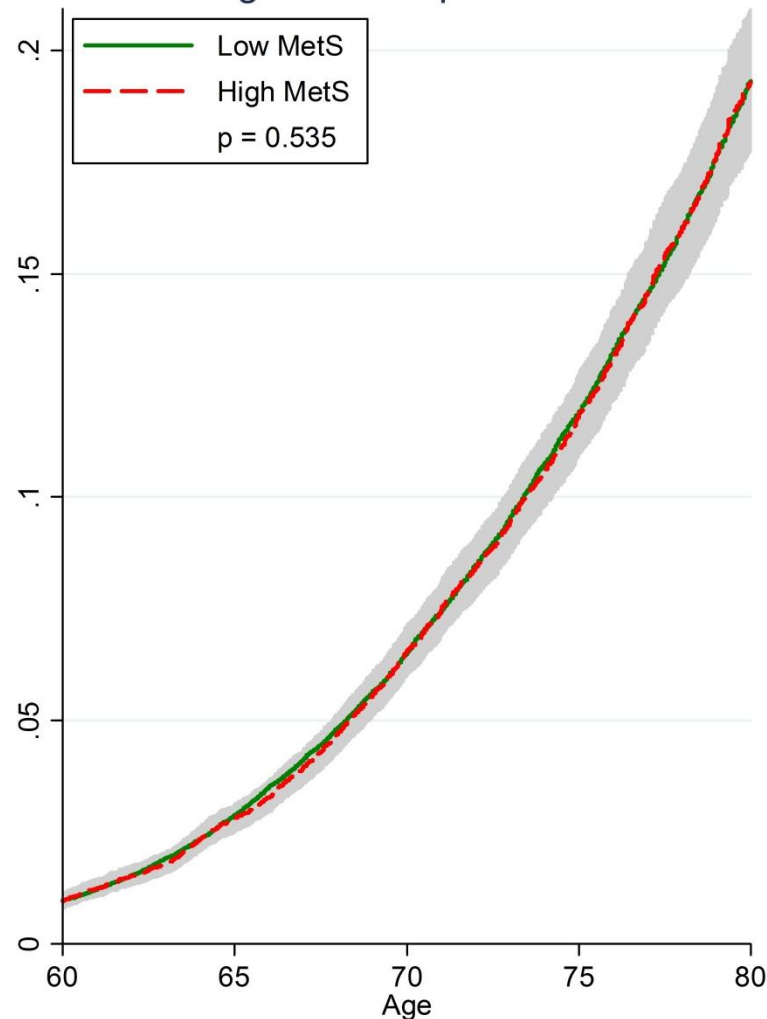


Cumulative incidence in relation to the competing event



Competing risk approach: incident prostate cancer

Conditional probability of prostate cancer
assuming survival up to certain time





Cause specific vs Comp risk → Cox vs Fine&Gray

```
stset dat_exit_inc, fail(prostate==1) id(id) origin(dat_b) enter(dat_m_plusly) scale(365.25)  
xi:stcox mets_normalized_new, strata( cohort_extra dat_b_5cat years_to_meas_in5cat smok)
```

[...]

```
No. of subjects =      279421          Number of obs   =      279421  
No. of failures =        6410  
Time at risk   =  3230475.165
```

[...]

| _t | Haz. Ratio | Std. Err. | z | P> z | [95% Conf. Interval] |
|--------------|------------|-----------|-------|-------|----------------------|
| mets_norma~w | .9713336 | .0131852 | -2.14 | 0.032 | .9458319 .9975229 |

Stratified by cohort_extra dat_b_5cat years_to_meas_in5cat smok

```
stset dat_2exit_inc, fail(risk2_inc==1) id(id) origin(dat_b) enter(dat_m_plusly) scale(365.25)  
xi:stcrreg mets_normalized_new i.smok i.cohort_extra i.dat_b_5cat i.years_to_meas_in5cat, compete(risk2_inc==2)
```

[..]

```
Competing-risks regression          No. of obs          =      280034  
                                     No. of subjects     =      280034  
Failure event  : risk2_inc == 2      No. failed          =        6798  
Competing event: risk2_inc == 1      No. competing       =       27836  
                                     No. censored        =      245400
```

[..]

| _t | SHR | Robust Std. Err. | z | P> z | [95% Conf. Interval] |
|--------------|----------|------------------|-------|-------|----------------------|
| mets_norma~w | .9256893 | .0113877 | -6.28 | 0.000 | .9036368 .94828 |

[..]



Fine & Gray regression estimates

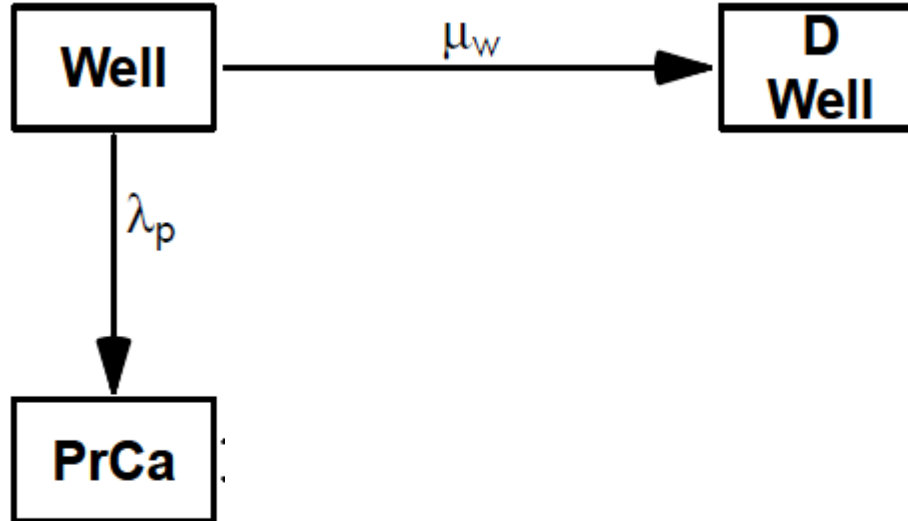
Confidential.

Removed on the web version

Further work?

To get a full spectrum of the prostate cancer scenario

Multi-state modelling



Questions?

Thank you!

Me-Can project:

Bergen, Norway: Tone Björge, Anders Engeland

Malmö, Sweden: Jonas Manjer

Copenhagen, Denmark: Tanja Stocks

Ulm, Germany: Gabriele Nagel

Innsbruck, Austria: Hanno Ulmer, Wegene Borena

Umeå: Pär Stattin, Håkan Jonsson, Sara Wiren, Christel Häggström