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periodR – an R package to calculate long term cancer survival estimates using period analysis

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B Holleczek[1], A Gondos[2], H Brenner[2]

[1] Saarland Cancer Registry (Saarbrücken)

[2] German Cancer Research Center, Division for Clinical Epidemiology and Aging Research (Heidelberg)

Saarland
Ministerium für Justiz, Arbeit, Gesundheit und Soziales

dkfz. GERMAN CANCER RESEARCH CENTER IN THE HELMHOLTZ ASSOCIATION

periodR – an R package for survival estimation using period analysis

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period analysis

- **long term survival** is key outcome parameter reported by cancer registries
- **period analysis**: reflects survival experience within a restricted recent calendar period („left truncation“)
- **method**: cumulative survival rates based on estimated conditional survival for subsequent time intervals after diagnosis (life table methodology)
- up-to-date prediction of results of traditional survival analysis (**early detection of changes in survival**)
- **empirically evaluated** and widespread use by cancer registries

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period analysis vs. traditional cohort based analysis

Diagnose	Nachbeobachtung												
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1992	1	1/2	2/3	3/4	4/5	5/6	6/7	7/8	8/9	9/10	10		
1993		1	1/2	2/3	3/4	4/5	5/6	6/7	7/8	8/9	9/10	10	
1994			1	1/2	2/3	3/4	4/5	5/6	6/7	7/8	8/9	9/10	10
1995				1	1/2	2/3	3/4	4/5	5/6	6/7	7/8	8/9	9/10
1996					1	1/2	2/3	3/4	4/5	5/6	6/7	7/8	8/9
1997						1	1/2	2/3	3/4	4/5	5/6	6/7	7/8
1998							1	1/2	2/3	3/4	4/5	5/6	6/7
1999								1	1/2	2/3	3/4	4/5	5/6
2000									1	1/2	2/3	3/4	4/5
2001										1	1/2	2/3	3/4
2002											1	1/2	2/3
2003												1	1/2
2004													1

traditional cohort based estimation of 10 year survival

period analysis based on observed survival between 2002-2004 (left truncation!)

mortality follow up available for end of period (2004)

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is a **language and environment for statistical computing and visualizing data**

- implements the S language
- available for **many OS** (Windows, Linux, MacOS)
- freely available under GNU public license
- **packages extend R** (provide additional **functions, datasets, documentation**)
- currently available version: R 2.5.1 (released 2007/06/28)
- september 2007: 1139 packages available from CRAN

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implements and extends **existing SAS macros** for period analysis

implementation/methodological details:

- calculation of **absolute and relative survival** based on conditional survival estimates for **1-year intervals** following diagnosis
- methods for relative survival: **Ederer II** and **Hakulinen**
- **standard errors** (Cutler-Ederer-method),
- **age-standardization** (uses individual weights)

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the package contains

- functions for **period analysis** (also cohort, complete or hybrid analyses possible)
- functions for data visualization (**plotting** survival curves)
- **datasets** (stomach cancer data, tables with age specific survival probabilities of males and females in Germany 1993-2002)
- integrated **documentation** and executable **examples**

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stomach cancer data

dataset of 2302 cancer cases diagnosed in Saarland between 1993 and 2002 (DCO cases already excluded)

variables required for analysis

- sex
- age at diagnosis
- month and year of diagnosis
- month and year of end of follow up
- vital status at end of follow up

for relative survival needed: **lifetable data** of age and sex specific survival probabilities

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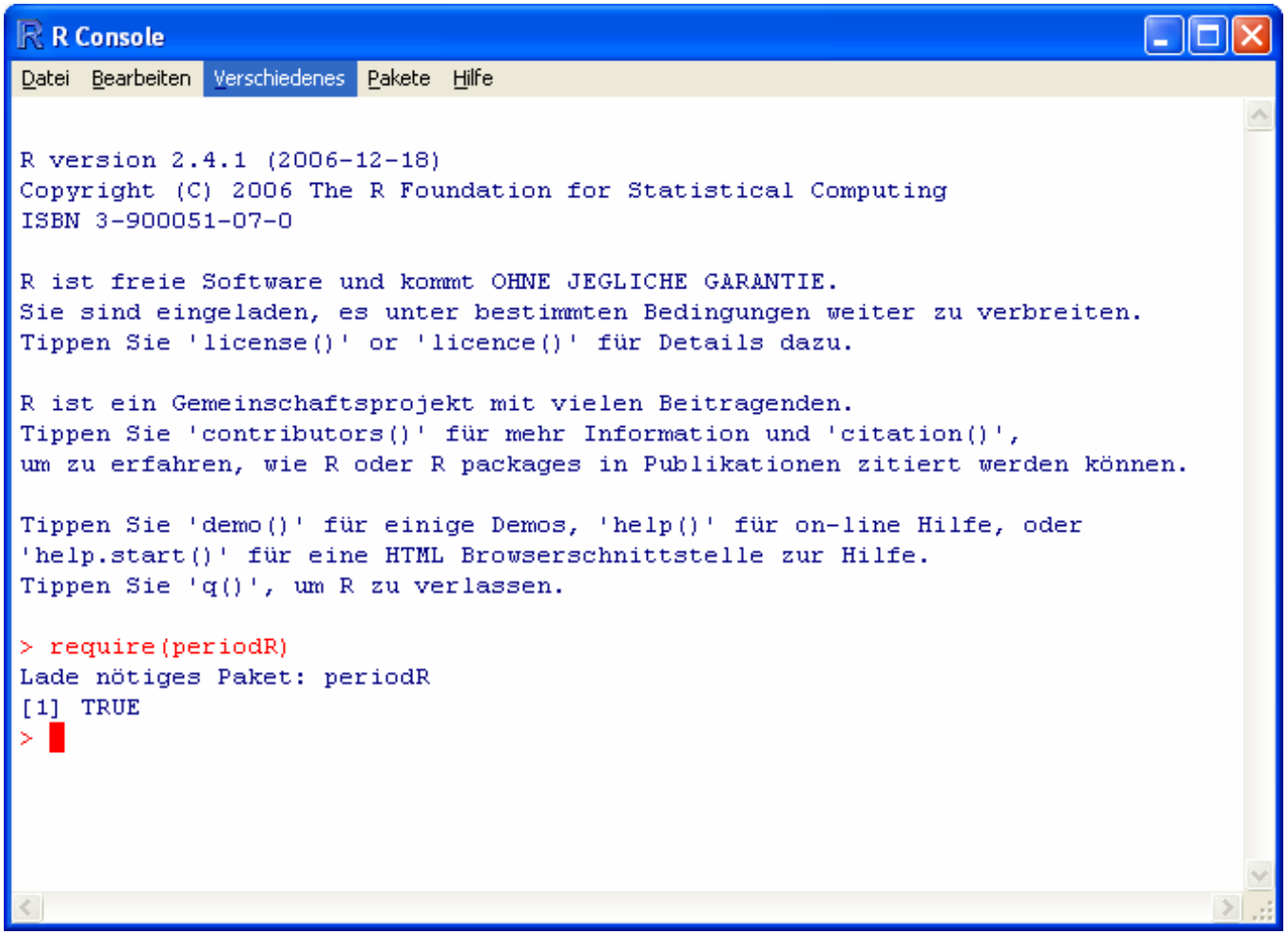
start of R session



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example analysis 1

```
> data(stomach)
> data(surv.probs.males)
> data(surv.probs.females)
>
> result <- period(data=stomach, k=10, surv.probs.males,
                   surv.probs.females, perbeg=2000, perend=2002,
                   method="hakulinen")
>
> print(result)
estimated survival using period analysis:
Call: period(data=stomach, k=10, surv.probs.males, surv.probs.females,
         perbeg=2000, perend=2002, method="hakulinen")

method used for relative survival: hakulinen
adjusted for age: no
observations included: 1164
```

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example analysis 2

```
estimates:
   year abs.surv err.abs rel.surv err.rel
1     1   0.5066  0.0197   0.5287  0.0206
2     2   0.3770  0.0191   0.4108  0.0208
3     3   0.3128  0.0183   0.3560  0.0209
4     4   0.2802  0.0178   0.3344  0.0212
5     5   0.2614  0.0175   0.3280  0.0219
6     6   0.2338  0.0169   0.3088  0.0224
7     7   0.2177  0.0165   0.3029  0.0230
8     8   0.2021  0.0161   0.2968  0.0237
9     9   0.1831  0.0161   0.2844  0.0251
10   10   0.1831  0.0161   0.3015  0.0266
```

year = follow up year
abs.surv = observed survival at end of follow up year
err.abs = standard error of observed survival
rel.surv = relative survival at end of follow up year
err.rel = standard error of relative survival

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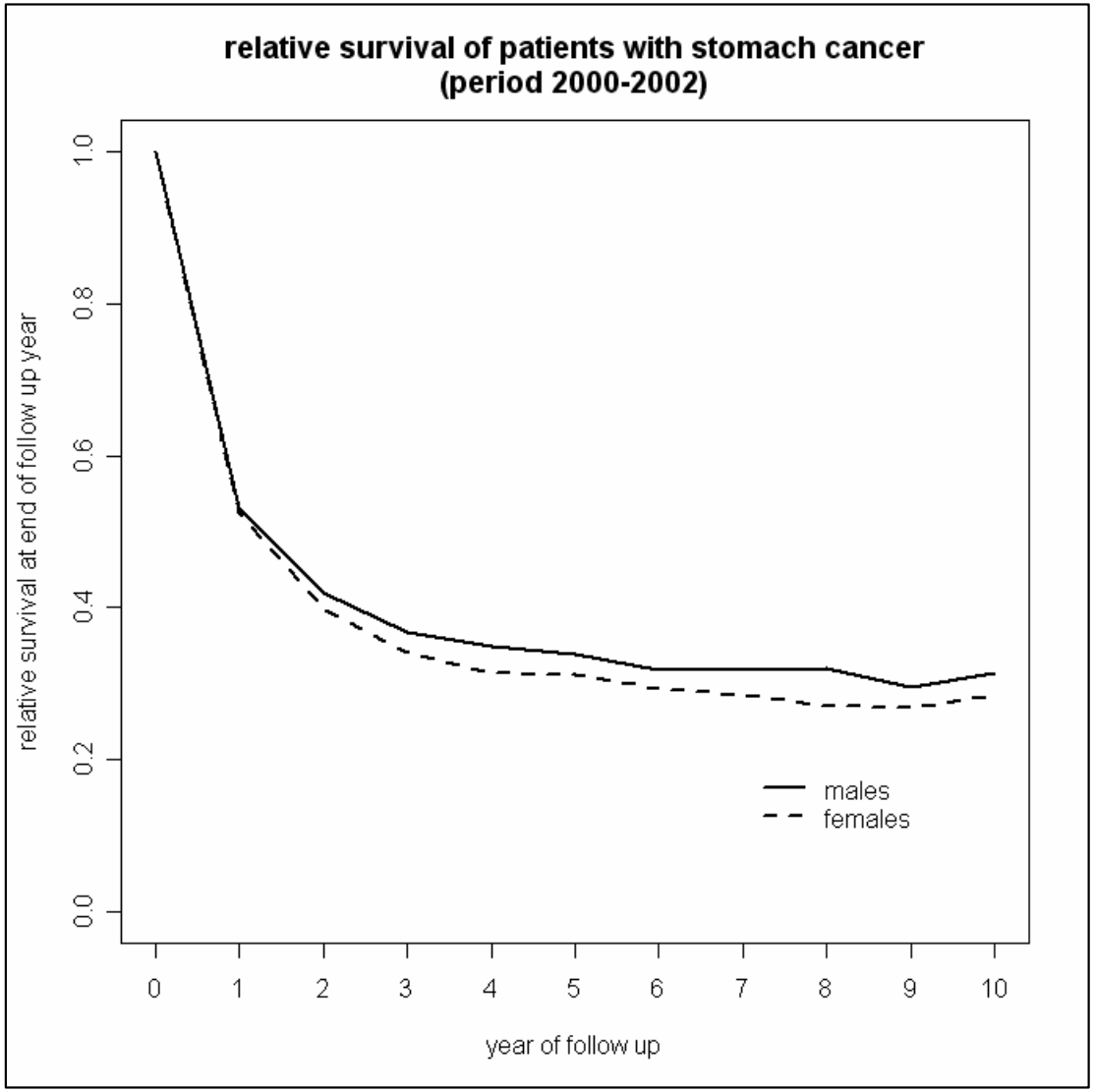
data visualization

plotted survival curves for both sexes for period 2000-2002 (stomach cancer data)



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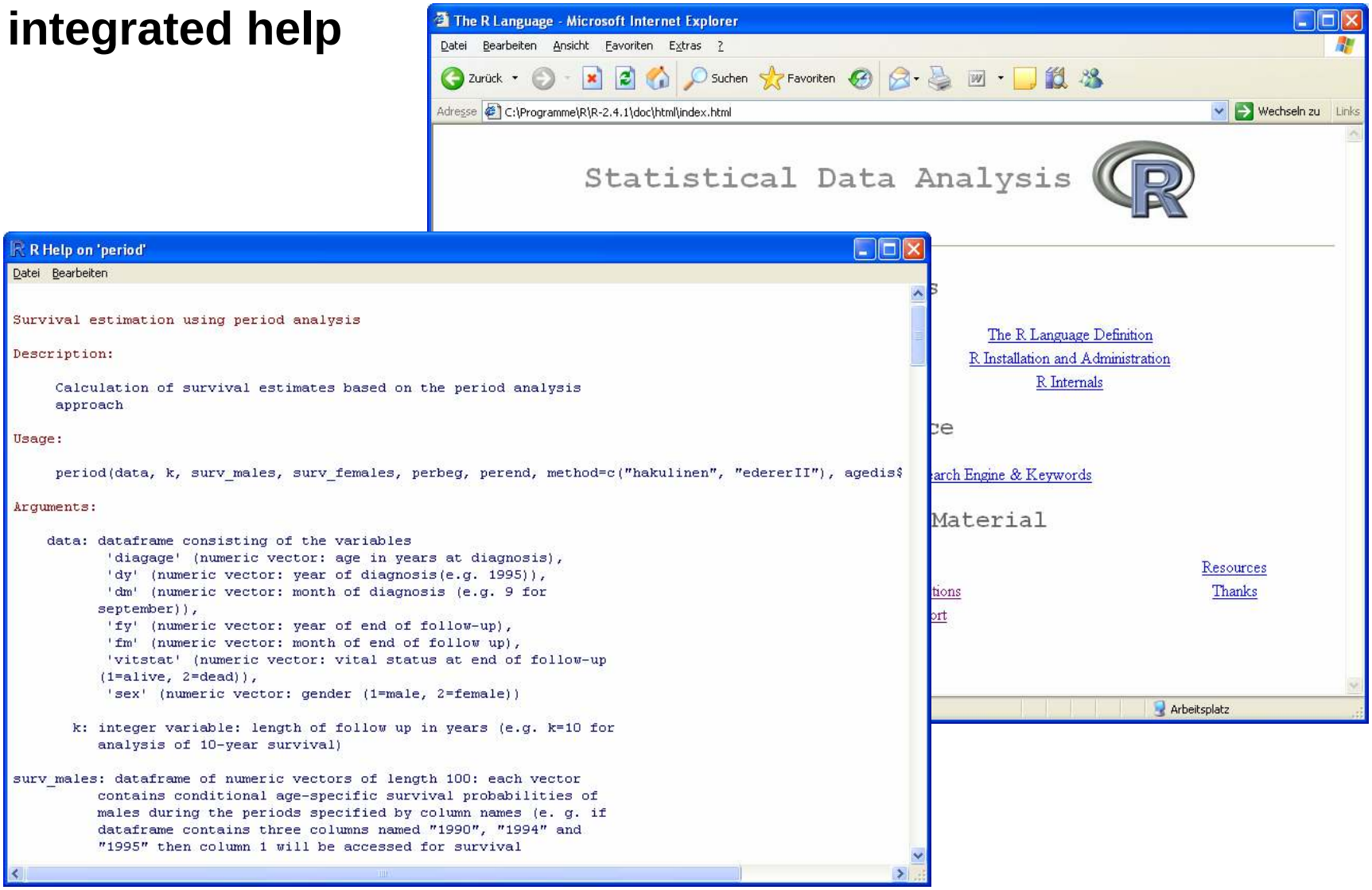
integrated help



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summary

periodR

- will be **freely available** under GNU public license
- intended to **enhance feasibility** and **application** of period analysis
- next step: **model based analysis**

further information/software

- http://www.R-project.org (R software, documentation, packages)
- http://www.krebsregister.saarland.de/improve (periodR)
- http://www.imbe.med.uni-erlangen.de/issan/SAS/period (SAS macros for absolute and relative survival rates)

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references

- Brenner H, Gefeller O. **An alternative approach to monitoring cancer patient survival**. Cancer 1996;78:2004-10.
- Brenner H, Hakulinen T. **Up-to-date long term survival estimates of patients with cancer by period analysis**. J Clin Oncol 2002;20:826-32
- Brenner H, Gefeller O, Hakulinen T. **Period analysis for up-to-date cancer survival data: theory, empirical evaluation, computational realization and applications**. Eur J Cancer 2004;40:326-35.