Temporal considerations and strategies (with applications in data analysis)

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Amsterdam March 30, 2007

This lecture has three parts. The first part discusses the consequences of temporal notions for empirical research, the second part will be on strategies used in research, and the consequences for the consultation interview. The last part will discuss the graphical representation of time-dependent notions and strategies.

Part I

TIME

Overview
- Preliminaries
- Analyzing change
- Example: Comparing two administration modes
- Two essential assumptions
- Provisions to represent time in statistics
The reason why . . .

In our conception of time, we seem to make a distinction in three classes: past, present and future.

As to the present: time is completely implicit and continuous. The most you can say that it is like a moving cut of a past/present dichotomy.

For the past and the future, time is conceptually attached to distinct ‘events’.
Provisions to represent time in statistics

- Repeated measurements
- Time series analysis
- Event history analysis

Statistics: abundant provisions to represent time

Example: Event history analysis (Blossfeld & Rohwer, 2002)

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Monthly MRI scans in multiple sclerosis

Is month the right time span?

+ Herman, you look like ...
**Definition of Maziness**

The *maziness* of a series of observations refers to the density of the inter-observation time spans.

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**Comparing two administration modes**

One of the most frequently used observer-rated scales to measure depression is the Montgomery Åsberg Depression Rating Scale (MADRS; Montgomery & Åsberg, 1979). In a study by Hermens et al. (2006), it was used to compare a telephonic and a face-to-face administration of 66 primary care patients with minor or mild major depression.

During an in-person interview at the patient's home, a trained interviewer administered the MADRS. A few days later the MADRS was administered again, but now by telephone and by a different interviewer.

Note that the order of the two administrations is always fixed. A cross-over design would have been better, but this was not used, due to practical constraints.

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**Analyzing a series of snapshots**

We analyze snapshot-data all the time. Since anything can change into anything else, trapping change by comparing snapshots can be misleading, in particular if the maziness of our observations is not tuned to the maziness of the phenomena we want to study.
Is there a memory effect?
A memory effect may occur within patients. If patients remember how they answered the questions at the first occasion, they may remember their answers the second time. This spoils our measurement of change.

To find out whether a memory effect did exist, we assumed that the number of days between the two ratings is a proxy for the memory effect (the more time between the ratings, the less the memory effect).

What if . . .
- . . . some patients have better memories than others?
- . . . or worse, one of the patients is an early-stage Alzheimer patient?
- (in other words) . . . there are individual differences in memory span?
- . . . memory span and depression are negatively related?

Two assumptions, essential to statistical manipulations

Assumption 1. Measurements mean the same for all respondents in the sample (measurement invariance). This also applies to their experience of time.

Assumption 2. The events each respondent experiences are not only assumed to be comparable with other respondents but can even be equalized in their placement in time. This also holds for the moment of intervention!

What if these assumptions are violated?
But this happens all the time! This is only harmful if it makes us draw the wrong conclusions. In other words, not all is lost if we use methods that are content robust.

Definition: content robustness
An research procedure is called content robust when we are confident that violations of its basic assumptions will have no disrupting effect on the conclusions drawn with respect to the research question.
Continuous time is not used in research methodology. Rather, we use events. This leads to a snapshot approach. Statistical techniques to analyze time galore. If observations are not tuned to the maziness of a phenomenon, we won’t get the right impression of change. Our analysis is based on two assumptions: (1) measurements mean the same for all respondents, even their experience of time; (2) observations are equalized in their placement in time. Violations are only harmful when we jeopardize the content robustness of our research procedure.
Examples: Low-level strategies
- Missing value analysis, multiple imputation
- Stepwise model search
- Bootstrapping and other resampling techniques
- Propensity scores to correct for bias

Doubtful strategy: modelling
Almost all statistical modelling is undertaken under the assumption that there will be one optimal model, not that there may be several alternative models.

Remarks:
- Statistics provides tools, not strategies
- Thoughtless use of Statistics can lead to wrong strategies (f. i. capitalizing on chance).
- Statistical procedures are based on statistical concepts, not on substantive ones (f. i. stepwise modelling techniques)
- The challenge of (the strategy of) methodological modelling is to make sure that the substantive background assumptions translate into the statistical model, so that statistical results can be interpreted in terms of subject matter (Adèr, Kuik, Hoeksma, & Mellenbergh, 2002)
**Strategies in Statistics**

**Strategy: definition**

Aim of a research strategy: content reliability

Optimizing a research strategy

Strategies in methodological consulting

Summary

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**Other high-level strategies in data analysis**

- Exploratory versus Confirmatory research: different analysis strategies required
- Therefore, combining exploratory and confirmatory analysis strategies is particularly challenging
- Crossvalidation can often be applied to solve this
- Similar observations for mixed methods (combining qualitative and quantitative methods)
- Structural equation modelling (over time)
- Bayesian approaches (if prior information indeed corresponds with substantive information)

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**Definition (Wikipedia):**

A strategy is a long term plan of action designed to achieve a particular goal, most often ‘winning’.

In our case, the goal is not ‘winning’ but research that is reliable and of high quality.

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**Remarks and questions**

- Strategy is defined as a series of subsequent activities with an aim
- In most cases you have to pick one strategy from a bundle of strategies (or you can make this selection ‘on the fly’) guided by some optimizing criterium
- What would be the aim of a research strategy?
- What could be defined as an optimizing approach in a research strategy?
Remarks

- Content reliability provides us with something to strive for, an *aim* of our research strategy. It guarantees that we can find out in what respect results ‘can be trusted’.

- There is an ethical aspect to this. If the report of the study does *not* provide the information to base our judgement on, we are at a loss. That is what the peer review process should guarantee.

- Here, we don’t go into the possibility of an author who, willingly or unwillingly, provides *wrong* information in his/her article.

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Optimizing a strategy in research methodology

Since our aim is high-quality research, our research strategy should be such that we can guarantee this quality. Research quality is multifaced:

... has the role of a **quality guardian**. He or she will advise his/her client to use a strategy that is aimed at an optimal (meaning: the best) research result, given the constraints of the study.

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Strategies in methodological consulting

Hasty publishing

Your client has just finished his data collection. In his initial analyses he has found an impressive effect of a new treatment developed by himself and his research group. He is now in a hurry to get his results published (He thinks publication in the Lancet is within reach.)

*Which points would you emphasize in the consultation meeting?*
However, the client . . .

. . . has other objectives. He wants to know:
- Do the data contain (statistically) significant results?
- Can I get my results published?
- If so, how fast?
- Can I submit to a journal with a high impact factor like the Lancet, Psychometrica, Journal of Educational Measurement?
- Can I publish before that research group in Vancouver does (they are working on the same stuff)?
- What will publication do to my reputation?

Consequence

Since strategies differ between Advisor and Client, the advisor should try to find out what the motivation of the client is:

Is there any common ground?!

In most cases the advisor and his/her client have a lot in common: they both want to convince the research community of the reliability of the conclusions of the study. In that sense their optimization criteria are the same.

Summary (Strategies)

- Statistics does not provide strategies, only tools to implement them
- The strategy of Edwards and Havránek to modelling offers an alternative to stepwise modelling
- The consultant and his/her client may have conflicting strategies. The client may have very pragmatic goals, whereas the consultant often plays the role of a quality guardian.
- But in the end they both aim for content reliability, i.e. to obtain sufficient information to be able to judge how much confidence can be placed in the study results
Part III

DIAGRAMS

Functional notation (Adèr, 1999)
Example: Progression in dementia (Adèr, The, & Pasman, 2003)
Example: Exploratory modelling (Adèr et al., 2002)
Strategies and Time
Summary
References

Overview
- Functional notation
- Example: Progression in dementia
- Example: Exploratory modelling
- Strategies and Time

The decision making process

Functional notation
F-notation is a special way of representing, for instance, a strategy. It has a graphical variant, which directly translates into the algebraic notation which resembles the specification of a regression or an structural equation model.

Temporal indications
F-notation has special provisions to indicate the placement in time of activities and objects.
The decision making process

**Strategies and Time**

**Summary**

**References**

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**strategies and time**

**future**

strategy

**present**

strategy

**past**

strategy

**Planning a strategy**

**Applying a strategy**

**Reporting on a strategy**
Summary (Diagrams)

- Functional notation
- Progression in dementia
- Exploratory modelling
- Temporal attributes to a strategy completely change its function and meaning


Abbreviations of the variables

MAL: Main location of the tumor
SWA: Swallowing
HDU: Hospitalization duration
MAC: Major Complications
MIC: Minor Complications
ANF: Antigen-DR at followup