An Introduction to a New Age-Period-Cohort Model for Describing and Investigating Inter-Cohort Differences and Intra-Cohort Dynamics Using **APCI** Package

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# **1 Introduction**

This document is a brief introduction of **APCI** package, in which the core function is **apci**. It is designed to implement the method for describing and investigating inter-cohort and intra-cohort dynamics in Luo and Hodge, 2019. ~~This package also includes functions like~~ **~~CohortDeviation~~** ~~and~~ **~~MainEffect~~**~~. They two functions aim to extract the slope and interaction of cohort effects, age-effects, as well as period-effects directly.~~

The **apci** function builds the APC-I model to solve the identification problem in the classical APC models and returns the coefficients for inter-cohort and intra-cohort dynamics. Different from the classical APC models where the effects are additive, APC-I model is based on a generalized linear regression including cohort effects as the interaction of age and period. Mathematically, the main model can be written as:

where is age effect, is the period effect, is the cohort effects.

Following the main model, a series of tests are implemented by the **apci** function, which can be controlled and selected by the users. The first one is a global F test. The global F test identifies if there are significant cohort effects in the dataset user imports. The second one is a deviation magnitude F test (also known as local F test). It tests which cohort(s) has(have) statistically significant cohort effects. The third test is a pair of inter-cohort and intra-cohort t tests, which examines the differences in average deviation between cohorts and the life course dynamics within cohorts.

# **1 Overview**

The **APCI** package implements the method of Age-Period-Cohort Interaction in the paper of Luo and Hodge, 2019. It solves the identification problems in previous models and provides and conceptual idea of the cohort effects.

# **2 Functions in the Package**

## **apci**

Fit the APC-I model and return the coefficients for inter-cohort and intra-cohort dynamics.

Usage

apci(outcome, acc, pcc, ccc, weight, covs, data, F.test=TRUE, …)

Arguments

outcome the outcome variable

acc age variable in the data

pcc period variable in the data

ccc cohort variable in the data

weight optional case weights

covs a list of optional covariances that control details of the model

data an optional data frame in which to interpret the variables named in acc, pcc, ccc, weights, and covs

F.test logical, if run the series of tests and return their results

Details

**apci** is the key function in APCI package. It provides a new way to describe the inter-cohort differences and intra-cohort dynamics by including the age-period interaction term.

Value

The estimation results are returned as a list with the following conponents:

model summary of the fitted generalized linear regression

step1gf results of the global F test

step2lf results of the local F test

intercept the intercept

age\_effect the estimated age effect

period\_effect the estimated period effect

cohort\_int the inter-cohort changes

cohort\_slope the intra-cohort changes

References

Luo and Hodge, 2019

Examples

library("APCI")

#Associating **APCI** package, the data of 1990-2014 Current Population Survey containing #1,071,234 white women aged 20 to 64 is automatically loaded, which is then used in this #example.

# fit model

APC\_I <- apci(outcome = "inlfc",

acc = "acc",

pcc = "pcc",

ccc = "ccc",

weight = "wt",

covs = c("age", "year", "educr", "educc"),

data = data,F.test=FALSE)

# check results

summary(APC\_I)

APC\_I$model

APC\_I$step1gf

APC\_I$step2lf

APC\_I$intercept

APC\_I$age\_effect

APC\_I$period\_effect

APC\_I$cohort\_int

APC\_I$cohort\_slope

## **cohortdeviation**

internal function, only used by the package APCI

Usage

cohortdeviation(A, P, C, model, weights, covs,…)

Argument

A the dimension of age

P the dimension of period

C the dimension of cohort

model a model fitted in temp\_model

weights optional case weights

covs a list of optional covariances that control details of the model

Values

cohort\_int the inter-cohort changes

cohort\_slope the intra-cohort changes

## **maineffect**

internal function, only used by the package APCI

Usage

maineffect(A, P, C, model, data,…)

Arguments

A the dimension of age

P the dimension of period

C the dimension of cohort

model a model fitted in temp\_model

data an optional data frame imported by the user

Value

intercept the intercept

age\_effect the estimated age effect

period\_effect the estimated period effect

## **temp\_model**

An internal function, only used by the package APCI. Fit the APC-I model.

Usage

temp\_model(outcome, acc, pcc, ccc, weight, covs, data, …)

Arguments

outcome the outcome variable

acc age variable in the data

pcc period variable in the data

ccc cohort variable in the data

weight optional case weights

covs a list of optional covariances that control details of the model

data an optional data frame in which to interpret the variables named in acc, pcc, ccc, weights, and covs

Value

A the dimension of age

P the dimension of period

C the dimension of cohort

model model fitted

## **tests**

An internal function, only used by the package APCI. Implement the sets of statistical tests.

Usage

tests(model, A, P, C, cohort, data, weight, …)

Argument

model the model fitted in temp\_model

A the dimension of age

P the dimension of period

C the dimension of cohort

cohort the list of names for all the cohorts

weight optional case weights

Value

step1gf results of the global F test

step2lf results of the local F test