

# Package ‘APCI’

January 30, 2024

**Type** Package

**Title** A New Age-Period-Cohort Model for Describing and Investigating  
Inter-Cohort Differences and Life Course Dynamics

**Version** 1.0.7

**Maintainer** Jiahui Xu <jpx5053@psu.edu>

**Depends** R (>= 3.6.0)

**Description** It implemented Age-Period-Interaction Model (APC-I Model) proposed in the paper of Liying Luo and James S. Hodges in 2019. A new age-period-cohort model for describing and investigating inter-cohort differences and life course dynamics.

**Imports** survey, magrittr, dplyr, ggplot2, data.table, ggpubr, stringr,  
gee

**License** GPL-2

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 7.2.3

**NeedsCompilation** no

**Author** Jiahui Xu [aut, cre],  
Liying Luo [aut]

**Repository** CRAN

**Date/Publication** 2024-01-30 06:40:03 UTC

## R topics documented:

ageperiod_group	2
apci	3
apci.bar	6
apci.plot	7
apci.plot.heatmap	9
apci.plot.hexagram	10
apci.plot.raw	12
blackmen	14

blackwomen . . . . .	14
cohortdeviation . . . . .	15
compute_xcoordinate . . . . .	16
compute_ycoordinate . . . . .	17
cpsmen . . . . .	17
cpswomen . . . . .	18
maineffect . . . . .	18
simulation . . . . .	19
temp_model . . . . .	19
tests . . . . .	21
whitemen . . . . .	22
whitewomen . . . . .	23
women9017 . . . . .	23

<b>Index</b>	<b>25</b>
--------------	-----------

---

ageperiod_group	<i>Get the cohort index matrix for any age and period groups</i>
-----------------	--

---

## Description

This function returns the cohort index matrix for any age and period groups. The cohort index matrix will then be used to extract the cohort effects.

## Usage

```
ageperiod_group(
  age_range,
  period_range,
  age_interval = NULL,
  period_interval = NULL,
  age_group = NULL,
  period_group = NULL
)
```

## Arguments

age\_range, period\_range

Numeric vector indicating the actual age and period range (e.g., 10 to 59 years old from 2000 to 2019).

age\_interval, period\_interval, age\_group, period\_group

Numeric values or character vectors indicating how age and period are grouped. age\_interval and period\_interval are numbers indicating the width of age and period groups respectively. age\_group and period\_group are character vectors explicitly listing all potential age and period groups. Either age\_interval(period\_interval) or age\_group (period\_group) have to be defined when unequal\_interval is TRUE.

**Value**

a matrix representing the relationship among age, period, and cohort groups under the current setting.

**Examples**

```
## age and period groups have equal width
ageperiod_group(age_range = 10:59, period_range = 2000:2019,
  age_interval = 5, period_interval = 5)
ageperiod_group(age_range = 10:59, period_range = 2000:2019,
  age_group = c("10-14", "15-19", "20-24", "25-29",
    "30-34", "35-39", "40-44", "45-49",
    "50-54", "55-59"),
  period_group = c("2000-2004", "2005-2009", "2010-2014",
    "2015-2019"))

## age and period groups have unequal width
ageperiod_group(age_range = 10:59, period_range = 2000:2019,
  age_interval = 10, period_interval = 5)
ageperiod_group(age_range = 10:59, period_range = 2000:2019,
  age_group = c("10-19", "20-29", "30-39", "40-49", "50-59"),
  period_group = c("2000-2004", "2005-2009",
    "2010-2014", "2015-2019"))
```

---

apci

*Run APC-I model*


---

**Description**

Run APC-I model

**Usage**

```
apci(
  outcome = "inlfc",
  age = "acc",
  period = "pcc",
  cohort = NULL,
  weight = NULL,
  covariate = NULL,
  data,
  family = "quasibinomial",
  dev.test = TRUE,
  print = TRUE,
  gee = FALSE,
  id = NULL,
  corstr = "exchangeable",
```

```

unequal_interval = FALSE,
age_range = NULL,
period_range = NULL,
age_interval = NULL,
period_interval = NULL,
age_group = NULL,
period_group = NULL,
...
)

```

### Arguments

outcome	An object of class character containing the name of the outcome variable. The outcome variable can be continuous, categorical, or count.
age	An object of class character representing the age group index taking on a small number of distinct values in the data. Usually, the vector should be converted to a factor (or the terms of "category" and "enumerated type").
period	An object of class character, similar to the argument of age, representing the time period index in the data.
cohort	An optional object of class character representing cohort membership index in the data. Usually, the cohort index can be generated from the age group index and time period index in the data because of the intrinsic relationship among these three time-related indices.
weight	An optional vector of sample weights to be used in the model fitting process. If non-NULL, the weights will be used in the first step to estimate the model. Observations with negative weights will be automatically dropped in modeling.
covariate	An optional vector of characters, representing the name(s) of the user-specified covariate(s) to be used in the model. If the variable(s) are not found in data, there will be an error message reminding the users to check the data again.
data	A data frame containing the outcome variable, age group indicator, period group indicator, and covariates to be used in the model. If the variable(s) are not found in data, there will be an error message reminding the users to check the input data again.
family	Used to specify the statistical distribution of the error term and link function to be used in the model. Usually, it is a character string naming a family function. For example, family can be "binomial", "multinomial", or "gaussian". Users could also check R package glm for more details of family functions.
dev.test	Logical, specifying if the global F test should be implemented before fitting the APC-I model. If TRUE, apci will first run the global F test and report the test results; otherwise, apci will skip this step and return NULL. The default setting is TRUE. However, users should be aware that the algorithm will not automatically stop even if there is no significant age-by-period interactions based on the global F test.
print	Logical, specifying if the intermediate results should be displayed in the console when fitting the model. The default setting is TRUE to display the results of each procedure.

<code>gee</code>	Logical, indicating if the data is cross-sectional data or longitudinal/panel data. If TRUE, the generalized estimating equation will be used to correct the standard error estimates. The default is FALSE, indicating that the data are cross-sectional.
<code>id</code>	A vector of character, specifying the cluster index in longitudinal data. It is required when <code>gee</code> is TRUE. The length of the vector should be the same as the number of observations.
<code>corstr</code>	A character string, specifying a possible correlation structure in the error terms when <code>gee</code> is TRUE. The following are allowed: <code>independence</code> , <code>fixed</code> , <code>stat\M\_dep</code> , <code>non\_stat\M\_dep</code> , <code>exchangeable</code> , <code>AR-M</code> and <code>unstructured</code> . The default value is <code>exchangeable</code> .
<code>unequal_interval</code>	Logical, indicating if age and period groups are of the same interval width. The default is set as TRUE.
<code>age_range, period_range</code>	Numeric vector indicating the actual age and period range (e.g., 10 to 59 years old from 2000 to 2019).
<code>age_interval, period_interval, age_group, period_group</code>	Numeric values or character vectors indicating how age and period are grouped. <code>age_interval</code> and <code>period_interval</code> are numbers indicating the width of age and period groups respectively. <code>age_group</code> and <code>period_group</code> are character vectors explicitly listing all potential age and period groups. Either <code>age_interval(period_interval)</code> or <code>age_group(period_group)</code> have to be defined when <code>unequal_interval</code> is TRUE.
<code>...</code>	Additional arguments to be passed to the function.

### Value

A list containing:

<code>model</code>	The fitted generalized linear model.
<code>intercept</code>	The overall intercept.
<code>age_effect</code>	The estimated age main effect.
<code>period_effect</code>	The estimated period main effect.
<code>cohort_average</code>	The estimated inter-cohort average deviations from age and period main effects.
<code>cohort_slope</code>	The estimated intra-cohort life-course linear slopes.
<code>int_matrix</code>	A matrix containing the estimated coefficients for age-by-period interactions.
<code>cohort_index</code>	Indices indicating different cohorts.
<code>data</code>	Data used for fitting APC-I model.

### Examples

```
# load package
library("APCI")
# load data
test_data <- APCI::women9017
test_data$acc <- as.factor(test_data$acc)
```

```

test_data$pcc <- as.factor(test_data$pcc)
test_data$eduucc <- as.factor(test_data$eduucc)
test_data$educr <- as.factor(test_data$educr)

# fit APC-I model
APC_I <- APCI::apci(outcome = "inlfc",
                   age = "acc",
                   period = "pcc",
                   cohort = "ccc",
                   weight = "wt",
                   data = test_data, dev.test=FALSE,
                   print = TRUE,
                   family = "gaussian")
summary(APC_I)

# explore the raw data pattern
apci.plot.raw(data = test_data, outcome_var = "inlfc", age = "acc",
              period = "pcc")
## alternatively,
apci.plot(data = test_data, outcome_var = "inlfc", age = "acc", model=APC_I,
           period = "pcc", type = "explore")

# visualize estimated cohort effects with bar plot
apci.bar(model = APC_I, age = "acc",
          period = "pcc", outcome_var = "inlfc")

# visualize estimated cohort effects with heatmap plot
apci.plot.heatmap(model = APC_I, age = "acc", period = "pcc")
## alternatively,
apci.plot(data = test_data, outcome_var = "inlfc", age = "acc", model=APC_I,
           period = "pcc")

```

---

apci.bar

---

*Make barplot for cohort effect*


---

## Description

Visualize cohort effects estimated by APC-I model with bar plots.

## Usage

```
apci.bar(model, age, period, outcome_var, cohort_label = NULL, ...)
```

## Arguments

model	A list recording the results from function apci.
age	An object of class character representing the age group index taking on a small number of distinct values in the data. Usually, the vector should be converted to a factor (or the terms of "category" and "enumerated type").

period	An object of class character, similar to the argument of age, representing the time period index in the data.
outcome_var	An object of class character indicating the name of the outcome variable used in the model. The outcome variable can be a continuous, binary, categorical, or count variable.
cohort_label	An optional vector, representing the labels of cohort groups in the x axis.
...	Additional arguments to be passed to the function.

### Value

A bar plot visualizing the cohort effects estimated by APC-I model.

### Examples

```
# load package
library("APCI")
# load data
test_data <- APCI::women9017
test_data$acc <- as.factor(test_data$acc)
test_data$pcc <- as.factor(test_data$pcc)
test_data$educc <- as.factor(test_data$educc)
test_data$educr <- as.factor(test_data$educr)

# fit APC-I model
APC_I <- APCI::apci(outcome = "inlfc",
  age = "acc",
  period = "pcc",
  cohort = "ccc",
  weight = "wt",
  data = test_data, dev.test=FALSE,
  print = TRUE,
  family = "gaussian")
summary(APC_I)

## visualizing estimated cohort effects with bar plot
apci.bar(model = APC_I, age = "acc", period = "pcc")
```

---

apci.plot

*Plotting age and period raw scores and APC-I model results*


---

### Description

Arranging data exploration and model results representation in a harmonized way.

**Usage**

```
apci.plot(
  model,
  age,
  period,
  outcome_var,
  type = "model",
  quantile = NULL,
  ...
)
```

**Arguments**

model	A list recording the results from function <code>apci</code> .
age	An object of class character representing the age group index taking on a small number of distinct values in the data. Usually, the vector should be converted to a factor (or the terms of "category" and "enumerated type").
period	An object of class character, similar to the argument of <code>age</code> , representing the time period index in the data.
outcome_var	An object of class character indicating the name of the outcome variable used in the model. The outcome variable can be a continuous, binary, categorical, or count variable.
type	Character, "explore" or "model". If type is "explore", plots for age and period raw scores will be generated. If type is "model", model results will be plotted. The default setting is "model".
quantile	A number valued between 0 and 1, representing the desirable percentiles to be used in visualizing the data or model. If NULL, the original scale of the outcome variable will be used.
...	Additional arguments to be passed to the function.

**Value**

A plot with three panels showing the raw scores or APC-I model results.

**Examples**

```
# load package
library("APCI")
# load data
test_data <- APCI::women9017
test_data$acc <- as.factor(test_data$acc)
test_data$pcc <- as.factor(test_data$pcc)
test_data$educ <- as.factor(test_data$educ)
test_data$educr <- as.factor(test_data$educr)

# fit APC-I model
APC_I <- APCI::apci(outcome = "inlfc",
  age = "acc",
```



```

        period = "pcc",
        cohort = "ccc",
        weight = "wt",
        data = test_data, dev.test=FALSE,
        print = TRUE,
        family = "gaussian")
summary(APC_I)

## plot the raw pattern
apci.plot(data = test_data, outcome_var = "inlfc", age = "acc", model=APC_I,
          period = "pcc", type = "explore")
## plot the model results
apci.plot(data = test_data, outcome_var = "inlfc", age = "acc", model=APC_I,
          period = "pcc", type = "model")

```

---

apci.plot.heatmap      *Plot the heatmap for APC-I model*

---

## Description

Plot the heatmap to visualize cohort effects estimated by APC-I model.

## Usage

```

apci.plot.heatmap(
  model,
  age,
  period,
  color_map = NULL,
  color_scale = NULL,
  quantile = NULL,
  ...
)

```

## Arguments

model	A list recording the results from function apci.
age	An object of class character representing the age group index taking on a small number of distinct values in the data. Usually, the vector should be converted to a factor (or the terms of "category" and "enumerated type").
period	An object of class character, similar to the argument of age, representing the time period index in the data.
color_map	A vector, representing the color palettes to be used in the figure. The default setting is greys if color_map is NULL. Alternations, for example, can be c("blue", "yellow"), blues, etc.

color_scale	A vector including two numbers indicating the limit of the values to be plotted. The first number is the minimum value to be visualized and the second is the maximum value to be visualized. If NULL, the algorithm will automatically select the limits from the data (estimation results) to set up the scale.
quantile	A number valued between 0 and 1, representing the desirable percentiles to be used in visualizing the data or model. If NULL, the original scale of the outcome variable will be used.
...	Additional arguments to be passed to the function.

### Value

A heatmap visualizing cohort effects estimated by APC-I model.

### Examples

```
# load package
library("APCI")
# load data
test_data <- APCI::women9017
test_data$acc <- as.factor(test_data$acc)
test_data$pcc <- as.factor(test_data$pcc)
test_data$educ <- as.factor(test_data$educ)
test_data$educr <- as.factor(test_data$educr)

# fit APC-I model
APC_I <- APCI::apci(outcome = "inlfc",
                    age = "acc",
                    period = "pcc",
                    cohort = "ccc",
                    weight = "wt",
                    data = test_data, dev.test=FALSE,
                    print = TRUE,
                    family = "gaussian")

summary(APC_I)

# plot heatmap
apci.plot.heatmap(model=APC_I, age="acc", period="pcc", first_age = 20,
                  first_period = 1940, interval = 5)
```

---

apci.plot.hexagram      *Plot the hexagram heatmap*

---

### Description

Plot the cohort effect in the style of hexagram

**Usage**

```

apci.plot.hexagram(
  model,
  age,
  period,
  first_age,
  first_period,
  interval,
  first_age_isoline = NULL,
  first_period_isoline = NULL,
  isoline_interval = NULL,
  color_scale = NULL,
  color_map = NULL,
  line_width = 0.5,
  line_color = "grey",
  label_size = 0.5,
  label_color = "black",
  scale_units = "Quintile",
  wrap_cohort_labels = TRUE,
  quantile = NULL
)

```

**Arguments**

model	A list recording the results from function <code>apci</code> .
age	An object of class character representing the age group index taking on a small number of distinct values in the data. Usually, the vector should be converted to a factor (or the terms of "category" and "enumerated type").
period	An object of class character, similar to the argument of <code>age</code> , representing the time period index in the data.
first_age	The first age group.
first_period	The first period group.
interval	The width of age and period groups.
first_age_isoline	Isoline for the first age group.
first_period_isoline	Isoline for the first period group.
isoline_interval	Interval of isoline.
color_scale	A vector including two numbers indicating the limit of the values to be plotted. The first number is the minimum value to be visualized and the second is the maximum value to be visualized. If <code>NULL</code> , the algorithm will automatically select the limits from the data (estimation results) to set up the scale.
color_map	A vector, representing the color palettes to be used in the figure. The default setting is greys if <code>color_map</code> is <code>NULL</code> . Alternations, for example, can be <code>c("blue", "yellow")</code> , blues, etc.

line_width	Width of lines. Default is 0.5.
line_color	Line colors. Default is grey.
label_size	Axis label size. Default is 0.5.
label_color	Axis label color. Default is Black.
scale_units	Units of scales.
wrap_cohort_labels	Display the cohort label or not. The default is TRUE.
quantile	A number valued between 0 and 1, representing the desirable percentiles to be used in visualizing the data or model. If NULL, the original scale of the outcome variable will be used.

**Value**

A hexagram visualizing the APC-I model results.

**Examples**

```
# load package
library("APCI")
# load data
test_data <- APCI::women9017
test_data$acc <- as.factor(test_data$acc)
test_data$pcc <- as.factor(test_data$pcc)
test_data$educ <- as.factor(test_data$educ)
test_data$educr <- as.factor(test_data$educr)

# fit APC-I model
APC_I <- APCI::apci(outcome = "inlfc",
                    age = "acc",
                    period = "pcc",
                    cohort = "ccc",
                    weight = "wt",
                    data = test_data, dev.test=FALSE,
                    print = TRUE,
                    family = "gaussian")

summary(APC_I)

# plot hexagram
apci.plot.hexagram(model=APC_I, age="acc", period="pcc", first_age = 20,
                  first_period = 1940, interval = 5)
```

---

apci.plot.raw

*Plotting age and period patterns*


---

**Description**

Visualize the age and period patterns by plotting the raw scores in each age and period square.

**Usage**

```
apci.plot.raw(data, outcome_var, age, period, ...)
```

**Arguments**

data	A data frame containing the outcome variable, age group indicator, period group indicator, and covariates to be used in the model. If the variable(s) are not found in data, there will be an error message reminding the users to check the input data again.
outcome_var	An object of class character indicating the name of the outcome variable used in the model. The outcome variable can be a continuous, binary, categorical, or count variable.
age	An object of class character representing the age group index taking on a small number of distinct values in the data. Usually, the vector should be converted to a factor (or the terms of "category" and "enumerated type").
period	An object of class character, similar to the argument of age, representing the time period index in the data.
...	Additional arguments to be passed to the function.

**Value**

A plot with two panels showing the age and period trends separately.

**Examples**

```
# load package
library("APCI")
# load data
test_data <- APCI::women9017
test_data$acc <- as.factor(test_data$acc)
test_data$pcc <- as.factor(test_data$pcc)
test_data$educ <- as.factor(test_data$educ)
test_data$educr <- as.factor(test_data$educr)

# fit APC-I model
APC_I <- APCI::apci(outcome = "inlfc",
                    age = "acc",
                    period = "pcc",
                    cohort = "ccc",
                    weight = "wt",
                    data = test_data, dev.test=FALSE,
                    print = TRUE,
                    family = "gaussian")

summary(APC_I)

# plot the raw pattern
apci.plot.raw(data = test_data, outcome_var = "inlfc", age = "acc",
              period = "pcc")
```

---

blackmen	<i>Black Men</i>
----------	------------------

---

**Description**

the dataset for black men

**Usage**

```
data("blackmen")
```

**Format**

A data frame with 10000 observations on the following 7 variables.

asecwt weight

year a factor indicating period groups with levels 1 2 3 4 5 6

age a factor indicating age groups with levels 1 2 3 4 5 6 7 8 9

labforce labor Force participation rate

educ education level

educr education level

educc education level

---

blackwomen	<i>Black Women</i>
------------	--------------------

---

**Description**

Dataset for black women

**Usage**

```
data("blackwomen")
```

**Format**

A data frame with 10000 observations on the following 7 variables.

asecwt weight

year a factor indicating period groups

age a factor indicating age groups

labforce labor Force participation rate

educ education level

educr education level

educc education level

---

cohortdeviation	<i>Calculate cohort deviation</i>
-----------------	-----------------------------------

---

## Description

Calculate cohort deviation

## Usage

```
cohortdeviation(
  A,
  P,
  C,
  model = temp6,
  weight = "wt",
  covariate,
  gee = FALSE,
  unequal_interval = FALSE,
  age_range = NULL,
  period_range = NULL,
  age_interval = NULL,
  period_interval = NULL,
  age_group = NULL,
  period_group = NULL,
  ...
)
```

## Arguments

A, P, C	The numbers of age groups, period groups, and cohort groups separately.
model	A generalized linear regression model generated from the internal function temp_model
weight	An optional vector of sample weights to be used in the model fitting process. If non-NULL, the weights will be used in the first step to estimate the model. Observations with negative weights will be automatically dropped in modeling.
covariate	An optional vector of characters, representing the name(s) of the user-specified covariate(s) to be used in the model. If the variable(s) are not found in data, there will be an error message reminding the users to check the data again.
gee	Logical, indicating if the data is cross-sectional data or longitudinal/panel data. If TRUE, the generalized estimating equation will be used to correct the standard error estimates. The default is FALSE, indicating that the data are cross-sectional.
unequal_interval	Logical, indicating if age and period groups are of the same interval width. The default is set as TRUE.
age_range, period_range	Numeric vector indicating the actual age and period range (e.g., 10 to 59 years old from 2000 to 2019).

age\_interval, period\_interval, age\_group, period\_group  
 Numeric values or character vectors indicating how age and period are grouped. age\_interval and period\_interval are numbers indicating the width of age and period groups respectively. age\_group and period\_group are character vectors explicitly listing all potential age and period groups. Either age\_interval(period\_interval) or age\_group (period\_group) have to be defined when unequal\_interval is TRUE.

... Additional arguments to be passed to the function.

**Value**

A list containing:

cohort\_average The estimated inter-cohort average deviations from age and period main effects.  
 cohort\_slope The estimated intra-cohort life-course linear slopes.  
 int\_matrix A matrix containing the estimated coefficients for age-by-period interactions.  
 cohort\_index Indices indicating different cohorts.

---

compute\_xcoordinate *Calculate x coordinate value*

---

**Description**

Calculate x coordinate value for plotting hexagram in visualizing APC-I results.

**Usage**

```
compute_xcoordinate(p)
```

**Arguments**

p Period value.

**Value**

The coordinate value for x axis.



---

compute\_ycoordinate    *Calculate y coordinate value*

---

**Description**

Calculate y coordinate value for plotting hexagram in visualizing APC-I results.

**Usage**

```
compute_ycoordinate(p, a)
```

**Arguments**

p	Period value
a	Age value

**Value**

The coordinate value for y axis.

---

cpsmen                    *Labor force participation data for men from 1990 to 1979 in CPS*

---

**Description**

the dataset for men

**Usage**

```
data("cpsmen")
```

**Format**

A data frame with 10000 observations on the following 7 variables.

asecwt	weight
year	a factor indicating period groups with levels 1 2 3 4 5 6
age	a factor indicating age groups with levels 1 2 3 4 5 6 7 8 9
labforce	labor Force participation rate
educ	education level
educr	education level
educc	education level

---

cpswomen	<i>Labor force participation data for women from 1990 to 1979 in CPS</i>
----------	--

---

**Description**

the dataset for women

**Usage**

```
data("cpswomen")
```

**Format**

A data frame with 10000 observations on the following 7 variables.

asecwt weight

year a factor indicating period groups with levels 1 2 3 4 5 6

age a factor indicating age groups with levels 1 2 3 4 5 6 7 8 9

labforce labor Force participation rate

educ education level

educr education level

educc education level

---

maineffect	<i>Estimate age effect and period effect</i>
------------	--

---

**Description**

Estimate age and period effect from APCI model

**Usage**

```
maineffect(A, P, C, model = temp6, data, gee = FALSE, ...)
```

**Arguments**

A, P, C	The numbers of age groups, period groups, and cohort groups separately.
model	A generalized linear regression model generated from the internal function temp_model
data	A data frame containing the outcome variable, age group indicator, period group indicator, and covariates to be used in the model. If the variable(s) are not found in data, there will be an error message reminding the users to check the input data again.
gee	Logical, indicating if the data is cross-sectional data or longitudinal/panel data. If TRUE, the generalized estimating equation will be used to correct the standard error estimates. The default is FALSE, indicating that the data are cross-sectional.
...	Additional arguments to be passed to the function.

**Value**

A list containing:

intercept      The overall intercept.  
 age\_effect      The estimated age main effect.  
 period\_effect    The estimated period main effect.

---

simulation	<i>Simulated Dataset</i>
------------	--------------------------

---

**Description**

A simulated dataset for APC-I analysis.

**Usage**

```
data("simulation")
```

**Format**

A data frame with 10000 observations on the following 3 variables.

y a numeric  
 age a numeric  
 period a numeric

---

temp_model	<i>Estimate APC-I model</i>
------------	-----------------------------

---

**Description**

Estimate the APC-I original model. This is a generalized linear regression model.

**Usage**

```
temp_model(  
  data,  
  outcome = "inlfc",  
  age = "acc",  
  period = "pcc",  
  cohort = NULL,  
  weight = NULL,  
  covariate = NULL,  
  family = "quasibinomial",  
  gee = FALSE,
```

```

    id = NULL,
    corstr = "exchangeable",
    ...
)

```

### Arguments

data	A data frame containing the outcome variable, age group indicator, period group indicator, and covariates to be used in the model. If the variable(s) are not found in data, there will be an error message reminding the users to check the input data again.
outcome	An object of class character containing the name of the outcome variable. The outcome variable can be continuous, categorical, or count.
age	An object of class character representing the age group index taking on a small number of distinct values in the data. Usually, the vector should be converted to a factor (or the terms of "category" and "enumerated type").
period	An object of class character, similar to the argument of age, representing the time period index in the data.
cohort	An optional object of class character representing cohort membership index in the data. Usually, the cohort index can be generated from the age group index and time period index in the data because of the intrinsic relationship among these three time-related indices.
weight	An optional vector of sample weights to be used in the model fitting process. If non-NULL, the weights will be used in the first step to estimate the model. Observations with negative weights will be automatically dropped in modeling.
covariate	An optional vector of characters, representing the name(s) of the user-specified covariate(s) to be used in the model. If the variable(s) are not found in data, there will be an error message reminding the users to check the data again.
family	Used to specify the statistical distribution of the error term and link function to be used in the model. Usually, it is a character string naming a family function. For example, family can be "binomial", "multinomial", or "gaussian". Users could also check R package glm for more details of family functions.
gee	Logical, indicating if the data is cross-sectional data or longitudinal/panel data. If TRUE, the generalized estimating equation will be used to correct the standard error estimates. The default is FALSE, indicating that the data are cross-sectional.
id	A vector of character, specifying the cluster index in longitudinal data. It is required when gee is TRUE. The length of the vector should be the same as the number of observations.
corstr	A character string, specifying a possible correlation structure in the error terms when gee is TRUE. The following are allowed: independence, fixed, stat\M\_dep, non\_stat\M\_dep, exchangeable, AR-M and unstructured. The default value is exchangeable.
...	Additional arguments to be passed to the function.

**Value**

A list containing:

A	Age group index.
P	Period group index.
C	Cohort group index.
model	Fitted APCI models of outcome on predictors.

---

tests	<i>Local and global F test</i>
-------	--------------------------------

---

**Description**

Implement local and global F test for APC-I model

**Usage**

```
tests(
  model,
  age = "acc",
  period = "pcc",
  cohort = "ccc",
  A,
  P,
  C,
  data,
  weight = "wt",
  family,
  outcome,
  ...
)
```

**Arguments**

model	A generalized linear regression model generated from the internal function <code>temp_model</code>
age	An object of class character representing the age group index taking on a small number of distinct values in the data. Usually, the vector should be converted to a factor (or the terms of "category" and "enumerated type").
period	An object of class character, similar to the argument of age, representing the time period index in the data.
cohort	An optional object of class character representing cohort membership index in the data. Usually, the cohort index can be generated from the age group index and time period index in the data because of the intrinsic relationship among these three time-related indices.
A, P, C	The numbers of age groups, period groups, and cohort groups separately.

data	A data frame containing the outcome variable, age group indicator, period group indicator, and covariates to be used in the model. If the variable(s) are not found in data, there will be an error message reminding the users to check the input data again.
weight	An optional vector of sample weights to be used in the model fitting process. If non-NULL, the weights will be used in the first step to estimate the model. Observations with negative weights will be automatically dropped in modeling.
family	Used to specify the statistical distribution of the error term and link function to be used in the model. Usually, it is a character string naming a family function. For example, family can be "binomial", "multinomial", or "gaussian". Users could also check R package glm for more details of family functions.
outcome	An object of class character containing the name of the outcome variable. The outcome variable can be continuous, categorical, or count.
...	Additional arguments to be passed to the function.

**Value**

A list displaying the global F test results.

---

whitemen

*White Men*


---

**Description**

A dataset for white men.

**Usage**

```
data("whitemen")
```

**Format**

A data frame with 10000 observations on the following 7 variables.

asecwt weight

year a factor indicating period groups

age a factor indicating age groups

labforce labor Force participation rate

educ education level

educr education level

educc education level

---

whitewomen	<i>White Women</i>
------------	--------------------

---

**Description**

A dataset for white women.

**Usage**

```
data("whitewomen")
```

**Format**

A data frame with 10000 observations on the following 7 variables.

asecwt weight  
year a factor indicating period groups  
age a factor indicating age groups  
labforce labor Force participation rate  
educ education level  
educr education level  
educc education level

---

women9017	<i>women9017</i>
-----------	------------------

---

**Description**

A sample dataset

**Usage**

```
women9017
```

**Format**

A data frame with 1000 observations on the following 23 variables.

ac a numeric vector  
acc a numeric vector  
age a numeric vector  
cc a numeric vector  
ccc a numeric vector

cohort a numeric vector  
educ a numeric vector  
educc a numeric vector  
educr a numeric vector  
inlfc a numeric vector  
labforce a numeric vector  
lfc a numeric vector  
marst a numeric vector  
marstc a numeric vector  
marstr a numeric vector  
nc a numeric vector  
ncc a numeric vector  
nchild a numeric vector  
pc a numeric vector  
pcc a numeric vector  
wt a numeric vector  
wtsupp a numeric vector  
year a numeric vector

**Details**

test

**Source**

CPS

**References**

Luo and Hodges (2019)



# Index

## \* datasets

- blackmen, [14](#)
- blackwomen, [14](#)
- cpsmen, [17](#)
- cpswomen, [18](#)
- simulation, [19](#)
- whitemen, [22](#)
- whitewomen, [23](#)

  

- ageperiod\_group, [2](#)
- apci, [3](#)
- apci.bar, [6](#)
- apci.plot, [7](#)
- apci.plot.heatmap, [9](#)
- apci.plot.hexagram, [10](#)
- apci.plot.raw, [12](#)

  

- blackmen, [14](#)
- blackwomen, [14](#)

  

- cohortdeviation, [15](#)
- compute\_xcoordinate, [16](#)
- compute\_ycoordinate, [17](#)
- cpsmen, [17](#)
- cpswomen, [18](#)

  

- maineffect, [18](#)

  

- simulation, [19](#)

  

- temp\_model, [19](#)
- tests, [21](#)

  

- whitemen, [22](#)
- whitewomen, [23](#)
- women9017, [23](#)