**Syntax**

```
areg depvar [indepvars] [if] [in] [weight], absorb(varname) [options]
```

**options**

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td><code>*absorb(varname)</code></td>
</tr>
<tr>
<td>SE/Robust</td>
</tr>
<tr>
<td><code>vce(vcetype)</code></td>
</tr>
<tr>
<td>Reporting</td>
</tr>
<tr>
<td><code>level(#)</code></td>
</tr>
<tr>
<td><code>display_options</code></td>
</tr>
<tr>
<td><code>coeflegend</code></td>
</tr>
</tbody>
</table>

*`absorb(varname)` is required.

`indepvars` may contain factor variables; see [U] 11.4.3 Factor variables.

`depvar` and `indepvars` may contain time-series operators; see [U] 11.4.4 Time-series varlists.

`bootstrap`, `by`, `fp`, `jackknife`, `mi estimate`, `rolling`, and `statsby` are allowed; see [U] 11.1.10 Prefix commands.

`vce(bootstrap)` and `vce(jackknife)` are not allowed with the `mi estimate` prefix; see [MI] mi estimate.

Weights are not allowed with the `bootstrap` prefix; see [R] bootstrap.

`aweight`s are not allowed with the `jackknife` prefix; see [R] jackknife.

`aweight`s, `fweight`s, and `pweight`s are allowed; see [U] 11.1.6 weight.

`coeflegend` does not appear in the dialog box.

See [U] 20 Estimation and postestimation commands for more capabilities of estimation commands.

**Menu**

Statistics > Linear models and related > Other > Linear regression absorbing one cat. variable

**Description**

`areg` fits a linear regression absorbing one categorical factor. `areg` is designed for datasets with many groups, but not a number of groups that increases with the sample size. See the `xtreg, fe` command in [XT] xtreg for an estimator that handles the case in which the number of groups increases with the sample size.
Options

\texttt{absorb(varname)} specifies the categorical variable, which is to be included in the regression as if it were specified by dummy variables. \texttt{absorb()} is required.

\texttt{vce(vcetype)} specifies the type of standard error reported, which includes types that are derived from asymptotic theory (\texttt{ols}), that are robust to some kinds of misspecification (\texttt{robust}), that allow for intragroup correlation (\texttt{cluster clustvar}), and that use bootstrap or jackknife methods (\texttt{bootstrap}, \texttt{jackknife}); see [\texttt{R]} \texttt{vce} option.

\texttt{vce(ols)}, the default, uses the standard variance estimator for ordinary least-squares regression. Exercise caution when using the \texttt{vce(cluster clustvar)} option with \texttt{areg}. The effective number of degrees of freedom for the robust variance estimator is \( n_g - 1 \), where \( n_g \) is the number of clusters. Thus the number of levels of the \texttt{absorb()} variable should not exceed the number of clusters.

\texttt{level(#)}; see [\texttt{R]} \texttt{estimation options}.

\texttt{display_options}: \texttt{noomitted}, \texttt{vsquish}, \texttt{noemptycells}, \texttt{baselevels}, \texttt{allbaselevels}, \texttt{nofvlabel}, \texttt{fwwrap(#)}, \texttt{fwwrapon(style)}, \texttt{cformat(\%fmt)}, \texttt{pformat(\%fmt)}, \texttt{sformat(\%fmt)}, and \texttt{nolstretch}; see [\texttt{R]} \texttt{estimation options}.

The following option is available with \texttt{areg} but is not shown in the dialog box: \texttt{coeflegend}; see [\texttt{R]} \texttt{estimation options}.

Remarks and examples

Suppose that you have a regression model that includes among the explanatory variables a large number, \( k \), of mutually exclusive and exhaustive dummies:

\[ y = X\beta + d_1\gamma_1 + d_2\gamma_2 + \cdots + d_k\gamma_k + \epsilon \]

For instance, the dummy variables, \( d_i \), might indicate countries in the world or states of the United States. One solution would be to fit the model with \texttt{regress}, but this solution is possible only if \( k \) is small enough so that the total number of variables (the number of columns of \( X \) plus the number of \( d_i \)'s plus one for \( y \)) is sufficiently small—meaning less than \texttt{matsize} (see [\texttt{R]} \texttt{matsize}). For problems with more variables than the largest possible value of \texttt{matsize} (100 for Small Stata, 800 for Stata/IC, and 11,000 for Stata/SE and Stata/MP), \texttt{regress} will not work. \texttt{areg} provides a way of obtaining estimates of \( \beta \)—but not the \( \gamma_i \)'s—in these cases. The effects of the dummy variables are said to be absorbed.

Example 1

So that we can compare the results produced by \texttt{areg} with Stata’s other regression commands, we will fit a model in which \( k \) is small. \texttt{areg}'s real use, however, is when \( k \) is large.

In our automobile data, we have a variable called \texttt{rep78} that is coded 1, 2, 3, 4, and 5, where 1 means poor and 5 means excellent. Let’s assume that we wish to fit a regression of \texttt{mpg} on \texttt{weight}, \texttt{gear_ratio}, and \texttt{rep78} (parameterized as a set of dummies).
. use http://www.stata-press.com/data/r13/auto2
(1978 Automobile Data)
. regress mpg weight gear_ratio b5.rep78

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of obs = 69</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F( 6, 62) = 21.31</td>
</tr>
<tr>
<td>Model</td>
<td>1575.97621</td>
<td>6</td>
<td>262.662702</td>
<td>Prob &gt; F = 0.0000</td>
</tr>
<tr>
<td>Residual</td>
<td>764.226686</td>
<td>62</td>
<td>12.3262369</td>
<td>R-squared = 0.6734</td>
</tr>
<tr>
<td>Total</td>
<td>2340.2029</td>
<td>68</td>
<td>34.4147485</td>
<td>Adj R-squared = 0.6418</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Root MSE = 3.5109</td>
</tr>
</tbody>
</table>

| mpg    | Coef.  | Std. Err. | t     | P>|t|  | [95% Conf. Interval] |
|--------|--------|-----------|-------|------|---------------------|
| weight | -.0051031 | .0009206  | -5.54 | 0.000 | -0.0069433 - .003263 |
| gear_ratio | .901478 | 1.565552  | 0.58  | 0.567 | -2.228015 4.030971 |
| rep78  |        |           |       |      |                     |
| Poor   | -2.036937 | 2.740728  | -0.74 | 0.460 | -7.515574 3.4417   |
| Fair   | -2.419822 | 1.764338  | -1.37 | 0.175 | -5.946682 1.107039 |
| Average| -2.557432 | 1.370912  | -1.87 | 0.067 | -5.297846 .1829814 |
| Good   | -2.788389 | 1.395259  | -2.00 | 0.050 | -5.577473 .006939  |
| _cons  | 36.23782 | 7.01057   | 5.17  | 0.000 | 22.22389 50.25175  |

To fit the areg equivalent, we type

. areg mpg weight gear_ratio, absorb(rep78)

| mpg    | Coef.  | Std. Err. | t     | P>|t|  | [95% Conf. Interval] |
|--------|--------|-----------|-------|------|---------------------|
| weight | -.0051031 | .0009206  | -5.54 | 0.000 | -0.0069433 - .003263 |
| gear_ratio | .901478 | 1.565552  | 0.58  | 0.567 | -2.228015 4.030971 |
| _cons  | 34.05889 | 7.056383  | 4.83  | 0.000 | 19.95338 48.1644   |
| rep78  |        |           |       |      |                     |
|        | F(4, 62) = 1.117 | 0.356 |      | (5 categories) |

Both regress and areg display the same $R^2$ values, root mean squared error, and—for weight and gear_ratio—the same parameter estimates, standard errors, $t$ statistics, significance levels, and confidence intervals. areg, however, does not report the coefficients for rep78, and, in fact, they are not even calculated. This computational trick makes the problem manageable when $k$ is large. areg reports a test that the coefficients associated with rep78 are jointly zero. Here this test has a significance level of 35.6%. This $F$ test for rep78 is the same that we would obtain after regress if we were to specify test 1.rep78 2.rep78 3.rep78 4.rep78; see [R] test.

The model $F$ tests reported by regress and areg also differ. The regress command reports a test that all coefficients except that of the constant are equal to zero; thus, the dummies are included in this test. The areg output shows a test that all coefficients excluding the dummies and the constant are equal to zero. This is the same test that can be obtained after regress by typing test weight gear_ratio.
Technical note

areg is designed for datasets with many groups, but not a number that grows with the sample size. Consider two different samples from the U.S. population. In the first sample, we have 10,000 individuals and we want to include an indicator for each of the 50 states, whereas in the second sample we have 3 observations on each of 10,000 individuals and we want to include an indicator for each individual. areg was designed for datasets similar to the first sample in which we have a fixed number of groups, the 50 states. In the second sample, the number of groups, which is the number of individuals, grows as we include more individuals in the sample. For an estimator designed to handle the case in which the number of groups grows with the sample size, see the xtreg, fe command in [XT] xtreg.

Although the point estimates produced by areg and xtreg, fe are the same, the estimated VCEs differ when vce(cluster clustvar) is specified because the commands make different assumptions about whether the number of groups increases with the sample size.

Technical note

The intercept reported by areg deserves some explanation because, given $k$ mutually exclusive and exhaustive dummies, it is arbitrary. areg identifies the model by choosing the intercept that makes the prediction calculated at the means of the independent variables equal to the mean of the dependent variable: \[ \bar{Y} = \bar{x} \hat{\beta}. \]

\[
\begin{align*}
\text{. predict yhat} \\
\text{. summarize mpg yhat if rep78 != .} \\
\text{Variable} & \quad \text{Obs} & \text{Mean} & \text{Std. Dev.} & \text{Min} & \text{Max} \\
mpg & \quad 69 & 21.28986 & 5.866408 & 12 & 41 \\
yhat & \quad 69 & 21.28986 & 4.383224 & 11.58643 & 28.07367
\end{align*}
\]

We had to include if rep78 < . in our summarize command because we have missing values in our data. areg automatically dropped those missing values (as it should) in forming the estimates, but predict with the xb option will make predictions for cases with missing rep78 because it does not know that rep78 is really part of our model.

These predicted values do not include the absorbed effects (that is, the $d_i \gamma_i$). For predicted values that include these effects, use the xbd option of predict (see [R] areg postestimation) or see [XT] xtreg.

Example 2

areg, vce(robust) is a Huberized version of areg; see [P] _robust. Just as areg is equivalent to using regress with dummies, areg, vce(robust) is equivalent to using regress, vce(robust) with dummies. You can use areg, vce(robust) when you expect heteroskedastic or nonnormal errors. areg, vce(robust), like ordinary regression, assumes that the observations are independent, unless the vce(cluster clustvar) option is specified. If the vce(cluster clustvar) option is specified, this independence assumption is relaxed and only the clusters identified by equal values of clustvar are assumed to be independent.
Assume that we were to collect data by randomly sampling 10,000 doctors (from 100 hospitals) and then sampling 10 patients of each doctor, yielding a total dataset of 100,000 patients in a cluster sample. If in some regression we wished to include effects of the hospitals to which the doctors belonged, we would want to include a dummy variable for each hospital, adding 100 variables to our model. `areg` could fit this model by

```
. areg depvar patient_vars, absorb(hospital) vce(cluster doctor)
```

### Stored results

`areg` stores the following in `e()`:

**Scalars**

- `e(N)` number of observations
- `e(tss)` total sum of squares
- `e(df_m)` model degrees of freedom
- `e(rss)` residual sum of squares
- `e(df_r)` residual degrees of freedom
- `e(r2)` $R$-squared
- `e(r2_a)` adjusted $R$-squared
- `e(df_a)` degrees of freedom for absorbed effect
- `e(rmse)` root mean squared error
- `e(ll)` log likelihood
- `e(ll0)` log likelihood, constant-only model
- `e(N_clust)` number of clusters
- `e(F)` $F$ statistic
- `e(F_absorb)` $F$ statistic for absorbed effect (when `vce(robust)` is not specified)
- `e(rank)` rank of `e(V)`

**Macros**

- `e(cmd)` `areg`
- `e(cmdline)` command as typed
- `e(depvar)` name of dependent variable
- `e(absvar)` name of `absorb` variable
- `e(wtype)` weight type
- `e(wexp)` weight expression
- `e(title)` title in estimation output
- `e(clustvar)` name of cluster variable
- `e(vcotype)` `vcetype` specified in `vce()`
- `e(vctype)` title used to label Std. Err.

**Matrices**

- `e(b)` coefficient vector
- `e(Cns)` constraints matrix
- `e(V)` variance–covariance matrix of the estimators
- `e(V_modelbased)` model-based variance

**Functions**

- `e(sample)` marks estimation sample
Methods and formulas

`areg` begins by recalculating `depvar` and `indepvars` to have mean 0 within the groups specified by `absorb()`. The overall mean of each variable is then added back in. The adjusted `depvar` is then regressed on the adjusted `indepvars` with `regress`, yielding the coefficient estimates. The degrees of freedom of the variance–covariance matrix of the coefficients is then adjusted to account for the absorbed variables—this calculation yields the same results (up to numerical roundoff error) as if the matrix had been calculated directly by the formulas given in [R] `regress`.

`areg` with `vce(robust)` or `vce(cluster clustvar)` works similarly, calling `_robust` after `regress` to produce the Huber/White/sandwich estimator of the variance or its clustered version. See [P] `_robust`, particularly Introduction and Methods and formulas. The model $F$ test uses the robust variance estimates. There is, however, no simple computational means of obtaining a robust test of the absorbed dummies; thus this test is not displayed when the `vce(robust)` or `vce(cluster clustvar)` option is specified.

The number of groups specified in `absorb()` are included in the degrees of freedom used in the finite-sample adjustment of the cluster–robust VCE estimator. This statement is only valid if the number of groups is small relative to the sample size. (Technically, the number of groups must remain fixed as the sample size grows.) For an estimator that allows the number of groups to grow with the sample size, see the `xtreg, fe` command in [XT] `xtreg`.

References


Also see

[R] `areg postestimation` — Postestimation tools for `areg`

[R] `regress` — Linear regression

[MI] `estimation` — Estimation commands for use with `mi estimate`

[XT] `xtreg` — Fixed-, between-, and random-effects and population-averaged linear models

[U] 20 Estimation and postestimation commands