oprobit — Ordered probit regression

Description

oprobit fits ordered probit models of ordinal variable `depvar' on the independent variables `indepvars'. The actual values taken on by the dependent variable are irrelevant, except that larger values are assumed to correspond to “higher” outcomes.

Quick start

Ordinal probit model of `y' on `x1' and categorical variables `a' and `b'

```
oprobit y x1 i.a i.b
```

Model of `y' on `x1' and a one-period lagged value of `x1' using `tsset' data

```
oprobit y x1 L.x1
```

As above, but calculate results for each level of `catvar' and save statistics to `myfile.dta'

```
statsby, by(catvar) saving(myfile): oprobit y x1 L.x1
```

Menu

Statistics > Ordinal outcomes > Ordered probit regression
## Syntax

```plaintext
oprobit depvar [ indepvars ] [ if ] [ in ] [ weight ] [ , options ]
```

<table>
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<tr>
<th>options</th>
<th>Description</th>
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<td>Model</td>
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<tr>
<td><code>offset(varname)</code></td>
<td>include <code>varname</code> in model with coefficient constrained to 1</td>
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<tr>
<td><code>constraints(constraints)</code></td>
<td>apply specified linear constraints</td>
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<td><code>vce(vcetype)</code></td>
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<td>set confidence level; default is <code>level(95)</code></td>
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<td><code>nocnsreport</code></td>
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<td><code>display_options</code></td>
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<tr>
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<td><code>maximize_options</code></td>
<td>control the maximization process; seldom used</td>
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<td><code>collinear</code></td>
<td>keep collinear variables</td>
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<td><code>coeflegend</code></td>
<td>display legend instead of statistics</td>
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- `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.
- `bayes`, bootstrap, by, fmm, fp, jackknife, mfp, mi estimate, nestreg, rolling, statsby, stepwise, and svy are allowed; see [U] 11.1.10 Prefix commands. For more details, see [BAYES] bayes: oprobit and [FMM] fmm: oprobit.
- `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.
- `vce()` and weights are not allowed with the svy prefix; see [SVY] svy.
- `fweights`, `iweights`, and `pweights` are allowed; see [U] 11.1.6 weight.

`collinear` and `coeflegend` do not appear in the dialog box.

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

## Options

### Model

- `offset(varname), constraints(constraints);` see [R] Estimation options.

### SE/Robust

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

level(#)\textnormal{; see [R] Estimation options.}

nocnsreport\textnormal{; see [R] Estimation options.}

display\_options: noci, nopvalues, noomitted, vsquish, noemptycells, baselevels, allbaselevels, nofvlabel, fvwrap(#), fvwrapon(style), cformat(%fmt), pformat(%fmt), sformat(%fmt), and nolstretch; see [R] Estimation options.

Maximization

maximize\_options: difficult, technique\(\text{algorithm\_spec}\), iterate(#), [no]log, trace, gradient, showstep, hessian, showtolerance, tolerance(#), ltolerance(#), nrtolerance(#), nonrtolerance, and from\(\text{init\_specs}\); see [R] Maximize. These options are seldom used.

The following options are available with oprobit but is not shown in the dialog box:
collinear, coeflegend; see [R] Estimation options.

Remarks and examples

An ordered probit model is used to estimate relationships between an ordinal dependent variable and a set of independent variables. An ordinal variable is a variable that is categorical and ordered, for instance, “poor”, “good”, and “excellent”, which might indicate a person’s current health status or the repair record of a car. If there are only two outcomes, see [R] logistic, [R] logit, and [R] probit. This entry is concerned only with more than two outcomes. If the outcomes cannot be ordered (for example, residency in the north, east, south, or west), see [R] mlogit. This entry is concerned only with models in which the outcomes can be ordered. See [R] logistic for a list of related estimation commands.

In ordered probit, an underlying score is estimated as a linear function of the independent variables and a set of cutpoints. The probability of observing outcome \(i\) corresponds to the probability that the estimated linear function, plus random error, is within the range of the cutpoints estimated for the outcome:

\[
\Pr(\text{outcome}_j = i) = \Pr(\kappa_{i-1} < \beta_1 x_{1j} + \beta_2 x_{2j} + \cdots + \beta_k x_{kj} + u_j \leq \kappa_i)
\]

\(u_j\) is assumed to be normally distributed. In either case, we estimate the coefficients \(\beta_1, \beta_2, \ldots, \beta_k\) together with the cutpoints \(\kappa_1, \kappa_2, \ldots, \kappa_{I-1}\), where \(I\) is the number of possible outcomes. \(\kappa_0\) is taken as \(-\infty\), and \(\kappa_I\) is taken as \(+\infty\). All of this is a direct generalization of the ordinary two-outcome probit model.

Example 1

In example 2 of [R] ologit, we use a variation of the automobile dataset (see [U] 1.2.2 Example datasets) to analyze the 1977 repair records of 66 foreign and domestic cars. We use ordered logit to explore the relationship of rep77 in terms of foreign (origin of manufacture), length (a proxy for size), and mpg. Here we fit the same model using ordered probit rather than ordered logit:
. use https://www.stata-press.com/data/r16/fullauto
(Automobile Models)
. oprobit rep77 foreign length mpg
Iteration 0:  log likelihood = -89.895098
Iteration 1:  log likelihood = -78.106316
Iteration 2:  log likelihood = -78.020086
Iteration 3:  log likelihood = -78.020025
Iteration 4:  log likelihood = -78.020025

Ordered probit regression
Number of obs = 66
LR chi2(3) = 23.75
Prob > chi2 = 0.0000
Log likelihood = -78.020025
Pseudo R2 = 0.1321

rep77 Coef. Std. Err. z P>|z| [95% Conf. Interval]
foreign 1.704861 .4246796 4.01 0.000 .8725037 2.537217
length .0468675 .012648 3.71 0.000 .022078 .0716571
mpg .1304559 .0378628 3.45 0.001 .0562463 .2046656
/cut1 10.1589 3.076754 4.12 0.000 3.876581 16.44121
/cut2 11.21003 3.107527 5.12 0.000 4.227084 18.19398
/cut3 12.54561 3.155233 6.36 0.000 6.295242 18.79599
/cut4 13.98059 3.218793 7.67 0.000 7.603801 20.35743

We find that foreign cars have better repair records, as do larger cars and cars with better mileage ratings.

Stored results
oprobit stores the following in e():

Scalars
e(N) number of observations
e(N_cd) number of completely determined observations
e(k_cat) number of categories
e(k) number of parameters
e(k_aux) number of auxiliary parameters
e(k_eq) number of equations in e(b)
e(k_eq_model) number of equations in overall model test
e(k_dv) number of dependent variables
e(df_m) model degrees of freedom
e(r2_p) pseudo- $R^2$
e(ll) log likelihood
e(ll_0) log likelihood, constant-only model
e(N_clust) number of clusters
e(chi2) $\chi^2$
e(p) $p$-value for model test
e(rank) rank of e(V)
e(ic) number of iterations
e(rc) return code
e(converged) 1 if converged, 0 otherwise

Macros
e(cmd) oprobit
e(cmdline) command as typed
e(depvar) name of dependent variable
e(vtype) weight type
e(wexp) weight expression
e(title) title in estimation output
e(clustvar) name of cluster variable
e(offset) linear offset variable
e(chi2type) Wald or LR: type of model $\chi^2$ test
e(vce) vcetype specified in vce()
e(vcetype) title used to label Std. Err.
e(opt) type of optimization
e(which) max or min; whether optimizer is to perform maximization or minimization
e(ml_method) type of ml method
e(user) name of likelihood-evaluator program
e(technique) maximization technique
e(properties) b V
e(predict) program used to implement predict
e(marginsdefault) default predict() specification for margins
e(asbalanced) factor variables fvset as asbalanced
e(asobserved) factor variables fvset as asobserved

Matrices
e(b) coefficient vector
e(Cns) constraints matrix
e(ilog) iteration log (up to 20 iterations)
e(gradient) gradient vector
e(cat) category values
e(V) variance–covariance matrix of the estimators
e(V_modelbased) model-based variance

Functions
e(sample) marks estimation sample

In addition to the above, the following is stored in r():

Matrices
r(table) matrix containing the coefficients with their standard errors, test statistics, $p$-values, and confidence intervals

Note that results stored in r() are updated when the command is replayed and will be replaced when any r-class command is run after the estimation command.

Methods and formulas

See Methods and formulas of [R] ologit.

References


Long, J. S., and J. Freese. 2014. Regression Models for Categorical Dependent Variables Using Stata. 3rd ed. College Station, TX: Stata Press.


Also see

[R] **oprobit postestimation** — Postestimation tools for oprobit

[R] **heckoprobit** — Ordered probit model with sample selection

[R] **hetoprobit** — Heteroskedastic ordered probit regression

[R] **logistic** — Logistic regression, reporting odds ratios

[R] **mlogit** — Multinomial (polytomous) logistic regression

[R] **mprobit** — Multinomial probit regression

[R] **ologit** — Ordered logistic regression

[R] **probit** — Probit regression

[R] **zioprobit** — Zero-inflated ordered probit regression

[BAYES] **bayes: oprobit** — Bayesian ordered probit regression

[CM] **cmroprobit** — Rank-ordered probit choice model

[ERM] **eoprobit** — Extended ordered probit regression

[FMM] **fmm: oprobit** — Finite mixtures of ordered probit regression models

[ME] **meoprobit** — Multilevel mixed-effects ordered probit regression

[MI] **Estimation** — Estimation commands for use with mi estimate

[SVY] **svy estimation** — Estimation commands for survey data

[XT] **xtoprobit** — Random-effects ordered probit models

[U] **20 Estimation and postestimation commands**