**lsens — Graph sensitivity and specificity versus probability cutoff**

**Description**

`lsens` graphs sensitivity and specificity versus probability cutoff and optionally creates new variables containing these data.

`lsens` requires that the current estimation results be from `logistic`, `logit`, `probit`, or `ivprobit`; see [R] logistic, [R] logit, [R] probit, or [R] ivprobit.

**Quick start**

Graph sensitivity and specificity versus a probability cutoff using current estimation results

```
lsens
```

Generate variables v1, v2, and v3 to contain probability cutoffs, sensitivity, and specificity

```
lsens, genprob(v1) gensens(v2) genspec(v3)
```

Add “My Title” to graph

```
lsens, genprob(v1) gensens(v2) genspec(v3) title(My Title)
```

**Menu**

Statistics > Binary outcomes > Postestimation > Sensitivity/specificity plot
lsens — Graph sensitivity and specificity versus probability cutoff

Syntax

```
lsens [ depvar ] [ if ] [ in ] [ weight ] [ , options ]
```

options Description

Main
```
all             graph all observations in the data
```
```
genprob(varname) create variable containing probability cutoffs
```
```
gensens(varname) create variable containing sensitivity
```
```
genspec(varname) create variable containing specificity
```
```
replace         overwrite existing variables
```
```
nograph         suppress the graph
```

Advanced
```
beta(matname)   row vector containing model coefficients
```

Plot
```
connect_options affect rendition of the plotted points connected by lines
```

Add plots
```
addplot(plot)   add other plots to the generated graph
```

Y axis, X axis, Titles, Legend, Overall
```
twoway_options  any options other than by() documented in [G-3] twoway_options
```

Weights are allowed; see [U] 11.1.6 weight.
lsens is not appropriate after the svy prefix.

Options

Main
```
all             requests that the statistic be computed for all observations in the data, ignoring any if or in restrictions specified by the estimation command.
```
```
genprob(varname), gensens(varname), and genspec(varname) specify the names of new variables created to contain, respectively, the probability cutoffs and the corresponding sensitivity and specificity.
```
```
replace requests that existing variables specified for genprob(), gensens(), or genspec() be overwritten.
```
```
nograph suppresses graphical output.
```

Advanced
```
beta(matname) specifies a row vector containing model coefficients. The columns of the row vector must be labeled with the corresponding names of the independent variables in the data. The dependent variable depvar must be specified immediately after the command name. See Models other than the last fitted model later in this entry.
```

Connect options affect the rendition of the plotted points connected by lines; see `connect_options` in [G-2] `graph twoway scatter`.

Add plots

`addplot(plot)` provides a way to add other plots to the generated graph. See [G-3] `addplot_option`.

Y axis, X axis, Titles, Legend, Overall

twoay_options are any of the options documented in [G-3] `twoway_options`, excluding by(). These include options for titling the graph (see [G-3] `title_options`) and for saving the graph to disk (see [G-3] `saving_option`).

Remarks and examples

Remarks are presented under the following headings:

- Introduction
- Models other than the last fitted model

Introduction

lens plots sensitivity and specificity; it plots both sensitivity and specificity versus probability cutoff $c$. The graph is equivalent to what you would get from `estat classification` (see [R] `estat classification`) if you varied the cutoff probability $c$ from 0 to 1.

Example 1

We illustrate lens after logistic; see [R] `logistic`.

```stata
    . use https://www.stata-press.com/data/r16/lbw
    (Hosmer & Lemeshow data)
    . logistic low age i.race smoke ui
        (output omitted)
    . lens
```

![Graph showing sensitivity and specificity versus probability cutoff](image)

- Blue line represents Sensitivity
- Red line represents Specificity
**lsens** optionally creates new variables containing the probability cutoff, sensitivity, and specificity.

```stata
    . lsens, genprob(p) gensens(sens) genspec(spec) nograph
```

The variables created will have \( M + 2 \) distinct nonmissing values: one for each of the \( M \) covariate patterns, one for \( c = 0 \), and another for \( c = 1 \). Values are recorded for \( p = 0 \), for each of the observed predicted probabilities, and for \( p = 1 \). The total number of observations required to do this can be fewer than \( _N \), the same as \( _N \), or \( _N + 1 \), or \( _N + 2 \). If more observations are added, they are added at the end of the dataset and the values of the original variables are set to missing in the added observations. How the values added align with existing observations is irrelevant.

**Technical note**

(logistic, logit, probit, or ivprobit and lsens) keep track of the estimation sample. If you type, for instance, logistic... if x==1, then when you type lsens, the statistics will be calculated on the x==1 subsample of the data automatically.

You should specify if or in with lsens only when you wish to produce graphs and calculate statistics for a set of observations other than the estimation sample.

If the logistic model was fit with fweights, lsens properly accounts for the weights in its calculations. You do not have to specify the weights when you run lsens. Weights should be specified with lsens only when you wish to use a different set of weights.

**Models other than the last fitted model**

By default, lsens uses the last model fit. You may also directly specify the model to lsens by inputting a vector of coefficients with the beta() option and passing the name of the dependent variable depvar to lsens.

**Example 2**

Suppose that someone publishes the following logistic model of low birthweight:

\[
\Pr(\text{low} = 1) = F(-0.02 \text{age} - 0.01 \text{lwt} + 1.3 \text{black} + 1.1 \text{smoke} + 0.5 \text{ptl} + 1.8 \text{ht} + 0.8 \text{ui} + 0.5)
\]

where \( F \) is the cumulative logistic distribution. These coefficients are not odds ratios; they are the equivalent of what logit produces.

We can see whether this model fits our data. First, we enter the coefficients as a row vector and label its columns with the names of the independent variables plus _cons for the constant (see [P] matrix define and [P] matrix rownames).

```stata
    . use https://www.stata-press.com/data/r16/lbw3, clear
      (Hosmer & Lemeshow data)
    . matrix input b = (-0.02, -.01, 1.3, 1.1, .5, 1.8, .8, .5)
    . matrix colnames b = age lwt black smoke ptl ht ui _cons
```
We can use `lroc` (see [R] `lroc`) to examine the predictive ability of the model:

```
. lroc low, beta(b) nograph
Logistic model for low
number of observations = 189
area under ROC curve = 0.7275
```

The area under the curve indicates that this model does have some predictive power. We can obtain a graph of sensitivity and specificity as a function of the cutoff probability by typing

```
. lsens low, beta(b)
```

![Graph of sensitivity and specificity](image)

**Stored results**

`lsens` stores the following in `r()`:

- Scalars
  - `r(N)` number of observations

**Methods and formulas**

Let \( j \) index observations and \( c \) be the cutoff probability. Let \( p_j \) be the predicted probability of a positive outcome and \( y_j \) be the actual outcome, which we will treat as 0 or 1, although Stata treats it as 0 and non-0, excluding missing observations.

A prediction is classified as positive if \( p_j \geq c \) and otherwise is classified as negative. The classification is correct if it is positive and \( y_j = 1 \) or if it is negative and \( y_j = 0 \).

Sensitivity is the fraction of \( y_j = 1 \) observations that are correctly classified. Specificity is the percentage of \( y_j = 0 \) observations that are correctly classified.

Also see

[R] **logistic** — Logistic regression, reporting odds ratios
[R] **logit** — Logistic regression, reporting coefficients
[R] **probit** — Probit regression
[R] **ivprobit** — Probit model with continuous endogenous covariates
[R] **lroc** — Compute area under ROC curve and graph the curve
[R] **estat classification** — Classification statistics and table
[R] **estat gof** — Pearson or Hosmer–Lemeshow goodness-of-fit test
[R] **roc** — Receiver operating characteristic (ROC) analysis
[U] 20 Estimation and postestimation commands