Model Interpretation and Visualization using Stata

Iowa Social Research Center (ISRC) Workshop

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Regression Highlights

- A way to summarize the relationship between variables.
- Assuming there is a relationship between Y and the independent variable(s).
- Relationship may be linear (OLS) or non-linear (CLDV).
- **Regression helps our understanding of how our dependent variable of interest changes when one or more independent variables vary, while holding remaining variables fixed.**

Regression Tables

- Important to report regression results in publication quality
- NEVER USE STATA output
- Multiple ways to create tables that can be featured in Word, PowerPoint, LaTeX documents
- Information table should feature include:
  1. Coefficient Estimate (REQUIRED)
  2. Standard Errors (Could include test statistic or p-value)
  3. Significance Stars
  4. Model Fit Statistics are useful (e.g., R^2)

outreg2

- outreg2 is a user-written Stata program
- Provides a fast and easy to produce regression tables
- Basic Syntax: `outreg2 using` *`filename`*`, replace`
- outreg2 command is executed AFTER regression model is estimated

outreg2 Example

```
reg realrinc age i.female
outreg2 using Tables/model.tex, replace tex(fragment)
```

outreg2 Example

VARIABLES	(1) realrinc
age	255.8***
	(39.38)
Constant	9,558***
	(1,807)
Observations	1,201
R-squared	0.034

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Coefficient Plots

- Sometimes, regression models feature many variables
- Also, showing many numbers and stars can be difficult for some readers
- An alternative to reporting a table is a plot of the regression results

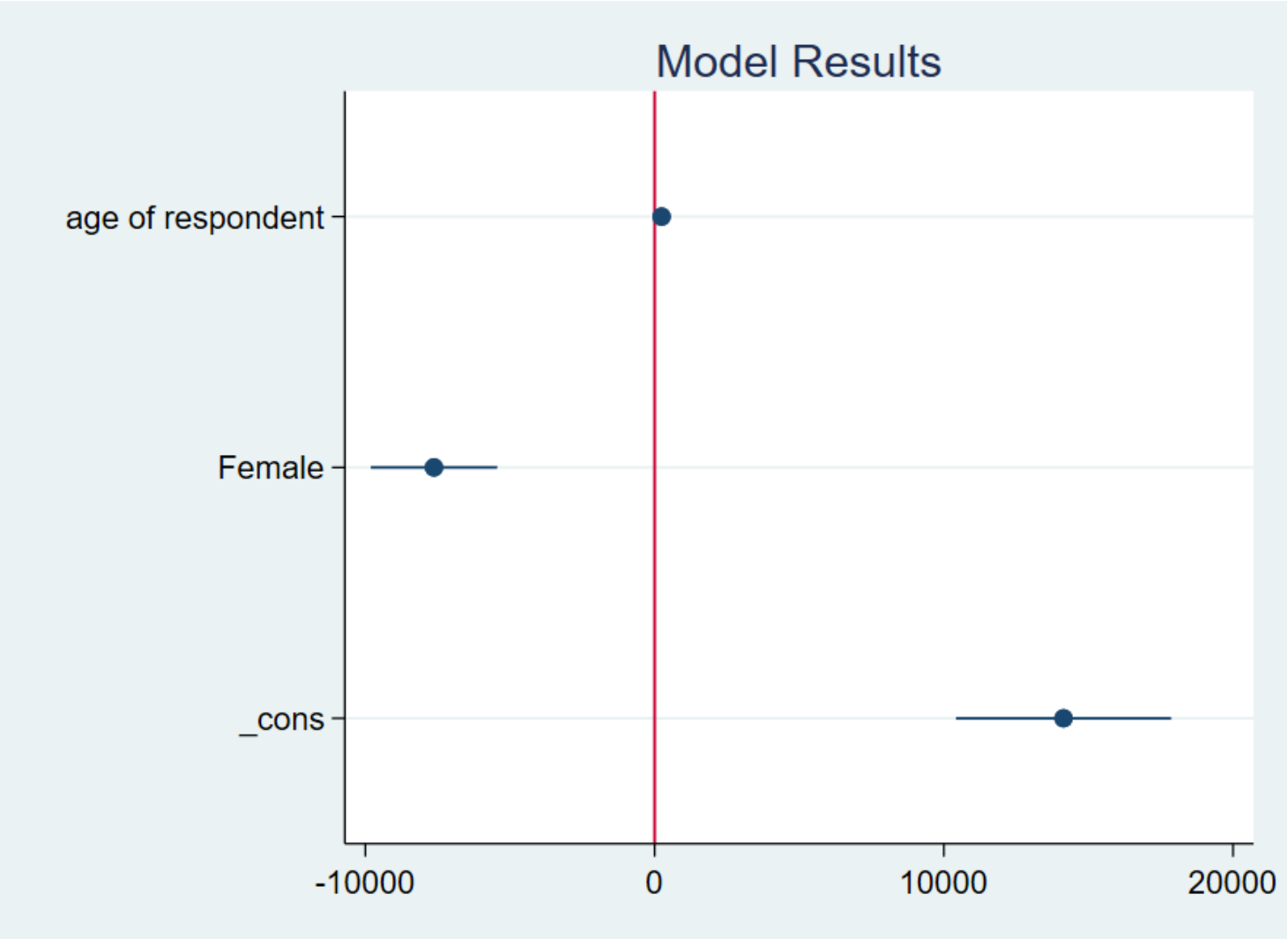
coefplot

- coefplot is another user-written Stata program
- Plots regression results in "dot-whisker" format
  - "Dot" – Coefficient Estimate
  - "Whisker" – Confidence Interval
- Basic Syntax: coefplot
- coefplot command is executed AFTER regression model is estimated

coefplot Example

```
reg realrinc age i.female
coefplot, title("Model Results") xline(0)
```

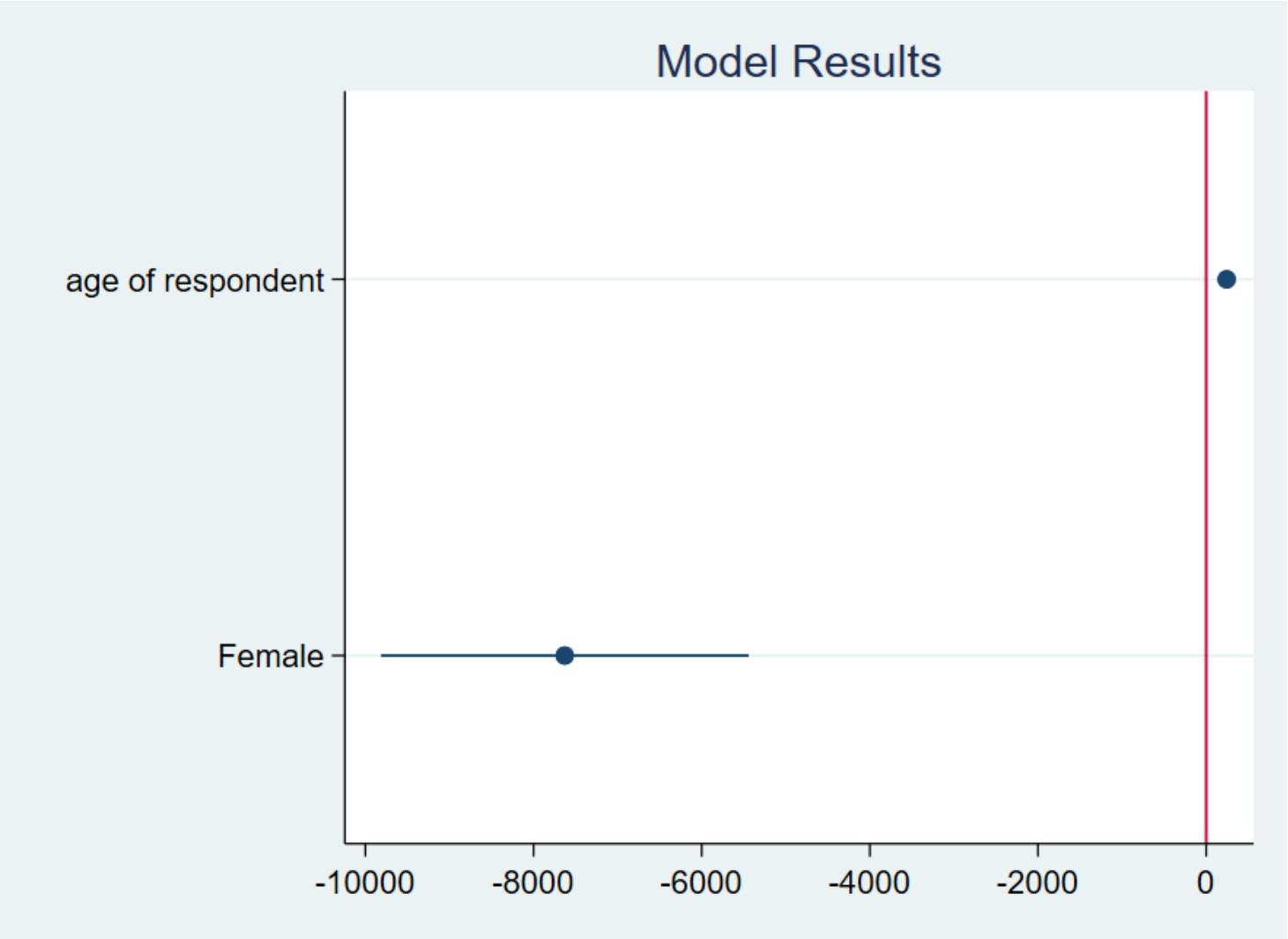
coefplot Example



coefplot Example

```
reg realrinc age i.female
coefplot, title("Model Results") xline(0) drop(_cons)
```

coefplot Example



Interpreting Coefficients

- Can directly interpret coefficient estimates.
- *A one unit change in X_k leads to a β_k change in Y (holding all other variables constant).*
- Assumes X_k is not a constituent term for an interaction variable.

Predicted (Fitted) Values

- The result of substituting values of interest for the independent variable(s).
- $E[Y|X] = X\hat{\beta}$
- Can calculate standard errors to determine if $E[Y|X = x]$ is statistically significantly different from zero.
- Multiple ways to calculate fitted values in Stata.

Marginal and Discrete Change

- Measuring the change in the dependent variable for a change in one independent variable, holding remaining independent variables constant.
  - *Marginal Change* is the partial derivative, or instantaneous rate of change, in the dependent variable w.r.t. an independent variable, holding remaining variables constant.
  - *Discrete Change* or *First Difference* is the difference in the prediction from one specified value of an independent variable to another specified value, holding remaining variables constant.

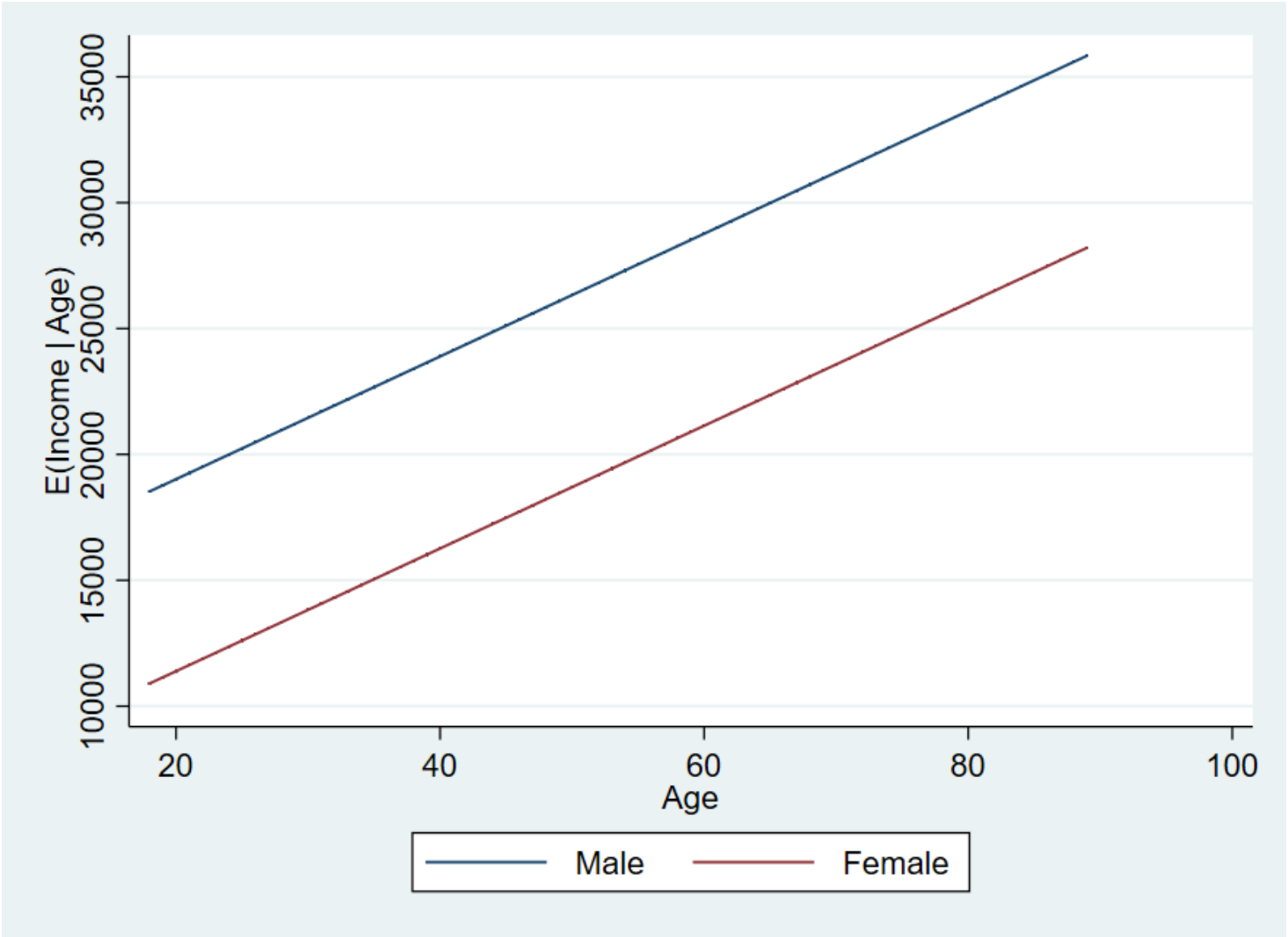
Marginal and Discrete Change

- Marginal Change: $\frac{\partial E[Y|X]}{\partial x_k} = \frac{\partial X\beta}{\partial x_k} = \beta_k$
- Discrete Change: $\frac{\Delta E[Y|X]}{\Delta x_k} = E[Y|X, x_k + 1] - E[Y|X, x_k] = \beta_k$

Marginal and Discrete Change

- $\frac{\partial E[Y|X]}{\partial x_k} = \frac{\Delta E[Y|X]}{\Delta x_k} = \beta_k$, assuming there is no interaction terms.
- The standard error of the marginal effect is the same as the standard error of the estimated beta coefficient.
- *For a unit increase in x_k, the expected change in Y equals β_k, holding all other variables constant.*
- *Having characteristic x_k (as opposed to not having the characteristic) results in an expected change of β_k in Y, holding all other variables constant.*
- When there is no interaction term present,
  Marginal Change = Discrete Change

Marginal Effects



margins

- Computes predicted values and marginal effects from last estimated regression model
- Reports computed statistic, standard error, test statistic, *p*-value and 95% CI.
- `at(atspec)` option allows for the calculation of predicted values and marginal effects at specific values of independent variable(s).
- `dydx()` option allows for calculating marginal effects.
- Factor variables (`i.varname`) can go after the `margins` command or within the `at(atspec)` option.
- Continuous variables can only be specified within the `at(atspec)` option.
- `atmeans` option sets variables not specified to be held at their mean value.

Predicted (Fitted) Values – `margins` Syntax

- `margins` – Overall predicted value with all independent variables held at their mean value.
- `margins, at(varname=#)` – Predicted value when one or more independent variables are fixed to a specific value and remaining independent variables held at their mean value.
- `margins, at(varname=numlist)` – Predicted value(s) when one or more independent variables are fixed to multiple values and remaining independent variables held at their mean value.
- `margins varname` – Overall predicted value(s) for categories of `varname` with remaining independent variables held at their mean value.

Marginal Change – `margins` Syntax

- `margins, dydx(varname)` – Average marginal effect a one-unit increase in `varname` has on the dependent variable, holding all other variables constant.

Discrete Change – margins Syntax

- `margins, at(varname=(start end)) post` – Calculates predicted values at specified values, and treats results as estimation results.
- `lincom 2._at - 1._at` – Calculates the difference between the prediction of the ending value and the prediction of the starting value.

marginsplot

- Graphs the results of last estimated `margins` command
- **Needs to be executed immediately after** `margins`
- Resulting graph includes an overall title, a title for the y-axis, x-axis features the name of the variable (variable label if one is included).
- The featured values on the x-axis are the values specified from the `margins` command.
- Can use the `recast` and `recastci` options to change how results are graphed.

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Any Questions?