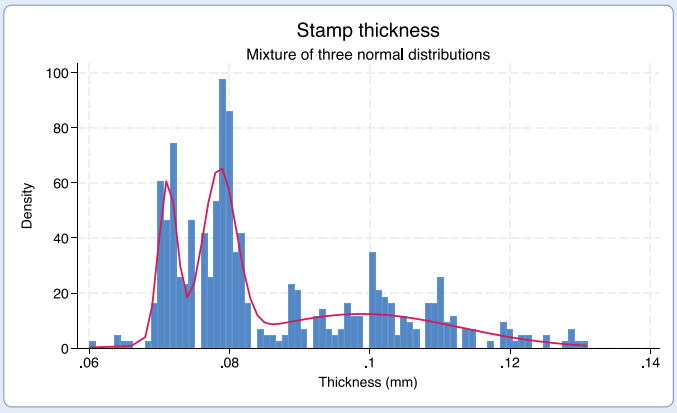
Finite mixture models (FMMs)

Do you have two or more groups in your data? Is group membership unobserved? Do your regression models differ across those groups? Or do the groups have different means? Or do they follow different distributions?



- Mixture models of two, three, or more unobserved groups (classes)
- Mixtures of a single estimator
- Mixtures combining different estimators or distributions
- **fmm** prefix, which can be used with 17 estimators
- Outcomes and mixture distributions can be continuous, binary, ordinal, count, categorical, fractional, censored, truncated, or even survival
- Predict
  - Group membership probabilities
  - Expected outcomes from the whole model
  - Expected outcomes assuming membership in a specific group
- Goodness of fit
  - AIC
  - BIC
  - Entropy New
- Model-comparison tests to select the number of groups
  - Vuong–Lo–Mendell–Rubin LR test New
  - Lo–Mendell–Rubin-adjusted LR test New

Fit your model

Mixture of two normal distributions

```
. fmm 2: regress y
```

Mixture of three normal distributions

```
. fmm 3: regress y
```

Mixture of three linear regression models

```
. fmm 3: regress y x1 x2
```

Mixture of three Poisson regression models

```
. fmm 3: poisson y x1 x2
```

Mixture of two logistic regression models

```
. fmm 2: logistic y x1 x2
```

Add predictors of group membership

```
. fmm 2, lcprob(x1 x3): logistic y x1 x2
```

Fit your model

Say we are interested in modeling the number of yearly doctor visits based on age, education level, whether the individual has private insurance or Medicaid, and whether the individual has a chronic illness. We believe the model may vary across two unobserved groups, so we type

```
. fmm 2: poisson drvisits i.private i.medicaid
                          age educ chronic
```

Estimate group means

estat lcmean reports the estimated mean—in this case, the estimated number of doctor visits—in each of the unobserved groups, that is, latent classes.

Viewer - view fmm1.smcl

view fmm1.smcl

Dialog | Also see | Jump to

```
. estat lcmean

Latent class marginal means                     Number of obs = 3,677
```

		Delta-method Margin	std. err.	z	P>|z|	[95% conf.	interval]
1							
	drvisits	3.836512	.0587946	65.25	0.000	3.721276	3.951747
2							
	drvisits	14.22566	.1849322	76.92	0.000	13.8632	14.58812

CAP NUM INS

Expected doctor visits are much higher for the second group.

Estimate group proportions

estat lcprob estimates the proportion of the population in each group.

Viewer - view fmm2.smcl

view fmm2.smcl

Dialog | Also see | Jump to

```
. estat lcprob

Latent class marginal probabilities             Number of obs = 3,677
```

	Delta-method Margin	std. err.	[95% conf.	interval]
Class				
1	.7156468	.0101609	.6953191	.7351349
2	.2843532	.0101609	.2648651	.3046809

CAP NUM INS

About 28% are in the second group—those expected to visit the doctor more frequently.

Advanced inferences

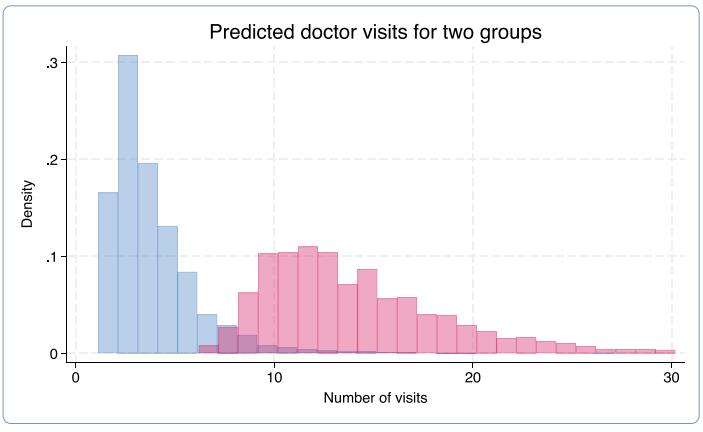
- Make inferences about the following:
  - Expected proportion of population in each group
  - Expected outcomes (means, probabilities, or counts) assuming membership in a group
  - Expected outcomes using model of all groups and membership probabilities
  - How covariates affect outcomes assuming membership in a group
  - How covariates affect outcomes considering all groups and membership probabilities
- Make inferences for groups or individuals:
  - Full population
  - Subpopulations
  - Expected outcomes for specific covariate values

Predictions

We can predict the number of doctor visits,

```
. predict drvis*, mu
```

and compare the resulting distributions using **twoway histogram**.



And this is just the beginning

Want different covariates in different groups?

```
. fmm: (regress y x1 x2)
       (regress y x1 x3)
```

Want different models in different groups?

```
. fmm: (poisson y x1 x2) (nbreg y x1 x2)
```

Want to fit a zero-inflated model?

```
. fmm: (poisson y x1 x2) (pointmass y)
```

stata.com/fmm