What is Discriminant Function Analysis and how is it used in Stata data analysis?

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Discriminant Function Analysis (DFA) is a statistical method used to classify observations into different groups based on a set of predictor variables. In Stata data analysis, DFA is used to identify the most important variables that discriminate between the groups and to create a predictive model for future observations. This method is particularly useful in situations where the response variable is categorical and the predictor variables are continuous. DFA can also be used to assess the overall effectiveness of the classification model and to compare the performance of different classification methods. Overall, DFA is a powerful tool for understanding the relationship between various variables and making predictions in data analysis using Stata.

Discriminant Function Analysis | Stata Data Analysis Examples

Version info: Code for this page was tested in Stata 12.

Linear discriminant function analysis (i.e., discriminant analysis) performs a multivariate test of differences between groups. In addition, discriminant analysis is used to determine the minimum number of dimensions needed to describe these differences. A distinction is sometimes made between descriptive discriminant analysis and predictive discriminant analysis. We will be illustrating predictive discriminant analysis on this page.

Please note: The purpose of this page is to show how to

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use various data
analysis commands. It does not cover all aspects of the research process which
researchers are expected to do. In particular, it does not cover data
cleaning and checking, verification of assumptions, model diagnostics or
potential follow-up analyses.

Examples of discriminant function analysis

Example 1.
A large international air carrier has collected data on employees in three different job
classifications: 1) customer service personnel, 2) mechanics and 3) dispatchers. The director of
Human Resources wants to know if these three job classifications appeal to different personality
types. Each employee is administered a battery of psychological test which include measures
of interest in outdoor activity, sociability and conservativeness.

Example 2.

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There is Fisher's (1936) classic example of discriminant analysis involving three varieties of iris and four predictor variables (petal width, petal length, sepal width, and sepal length). Fisher not only wanted to determine if the varieties differed significantly on the four continuous variables, but he was also interested in predicting variety classification for unknown individual plants.

Description of the data

Let's pursue Example 1 from above.

We have a data file, discrim.dta, with 244 observations on four variables. The psychological variables are outdoor interests, social and conservative. The categorical variable is job type with three levels; 1) customer service, 2) mechanic and 3) dispatcher.

Let's look at the data. It is always a good idea to start with descriptive

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statistics.

use https://stats.idre.ucla.edu/stat/stata/dae/discrim, clear

summarize outdoor social conservative

Variable | Obs Mean Std. Dev. Min Max
----------+---
outdoor | 244 15.63934 4.839933 0 28
social | 244 20.67623 5.479262 7 35
conservative | 244 10.59016 3.726789 0 20

tabstat outdoor social conservative, by(job) stat(n mean sd min max) col(stat)

Summary for variables: outdoor social conservative
by categories of: job

job | N mean sd min max
----------+---
customer service | 85 12.51765 4.648635 0 22
| 85 24.22353 4.335283 12 35
| 85 9.023529 3.143309 2 17
----------+---
mechanic | 93 18.53763 3.564801 11 28

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| 93 21.13978 4.55066 9 29
| 93 10.13978 3.242354 0 17
----------+----------
dispatch | 66 15.57576 4.110252 4 25
| 66 15.45455 3.766989 7 26
| 66 13.24242 3.69224 4 20
----------+----------
Total | 244 15.63934 4.839933 0 28
| 244 20.67623 5.479262 7 35
| 244 10.59016 3.726789 0 20
----

correlate outdoor social conservative
(obs=244)

| outdoor social conser~e
----------+----------
outdoor | 1.0000
social | -0.0713 1.0000
conservative | 0.0794 -0.2359 1.0000

tabulate job

job | Freq. Percent Cum.
----------+----------

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customer service | 85 34.84 34.84
mechanic | 93 38.11 72.95
dispatch | 66 27.05 100.00
----------+----------
Total | 244 100.00

Analysis methods you might consider

Below is a list of some analysis methods you may have encountered. Some of the methods listed are quite reasonable, while others
have either fallen out of favor or have limitations.

Discriminant function analysis

We will run the discriminant analysis using the candisc procedure. We could also have run the discrim lda command to get the same analysis with slightly different output. There is a great deal of output, so we will comment at various places
along the way.

candisc outdoor social conservative, group(job)

Canonical linear discriminant analysis

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| | Like-
| Canon. Eigen- Variance | lihood
Fcn | Corr. value Prop. Cumul. | Ratio F df1 df2 Prob>F
----+------------------------------+-----------------------------------
1 | 0.7207 1.08053 0.7712 0.7712 | 0.3640 52.382 6 478 0.0000 e
2 | 0.4927 .320504 0.2288 1.0000 | 0.7573 38.46 2 240 0.0000 e
----
Ho: this and smaller canon. corr. are zero; e = exact F

Standardized canonical discriminant function coefficients

| function1 function2
-------------+--------------------
outdoor | .3785725 .9261104
social | -.8306986 .2128593
conservative | .5171682 -.2914406

Canonical structure

| function1 function2
-------------+--------------------
outdoor | .3230982 .9372155

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social | -.7653907 .2660298

conservative | .467691 -.2587426

Group means on canonical variables

| job

--------+-----------------

group1 | customer service

group2 | mechanic

group3 | dispatch

| function1 function2

------------+----------------------

group1 | -1.2191 -.3890039

group2 | .1067246 .7145704

group3 | 1.419669 -.5059049

Resubstitution classification summary

+---------+

| Key |

|---------|

| Number |

| Percent |

+---------+

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| Classified
True | group1 group2 group3 | Total
-----------+---------------------+-------
group1 | 70 11 4 | 85
| 82.35 12.94 4.71 | 100.00
| |
group2 | 16 62 15 | 93
| 17.20 66.67 16.13 | 100.00
| |
group3 | 3 12 51 | 66
| 4.55 18.18 77.27 | 100.00
-----------+---------------------+-------
Total | 89 85 70 | 244
| 36.48 34.84 28.69 | 100.00
| |
Priors | 0.3333 0.3333 0.3333 |

The output includes the means on the discriminant functions for each of the three groups
and a classification table. Values in the diagonal of the classification table reflect
the correct classification of individuals into groups based on their scores on the

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discriminant dimensions.

By default, Stata assumes a priori an equal number of people in each job. This is represented by the 0.3333 Priors in the table above. If you have different expected proportions in mind, you may specify them with the priors option.

Next, we will plot a graph of individuals on the discriminant dimensions. Due to the large number of subjects we will shorten the labels for the job groups to make the graph more legible. As long as we do not save the dataset, these new labels will not be made permanent.

```
label define job 1 "c" 2 "m" 3 "d", modify

scoreplot,                                msymbol(i)
```

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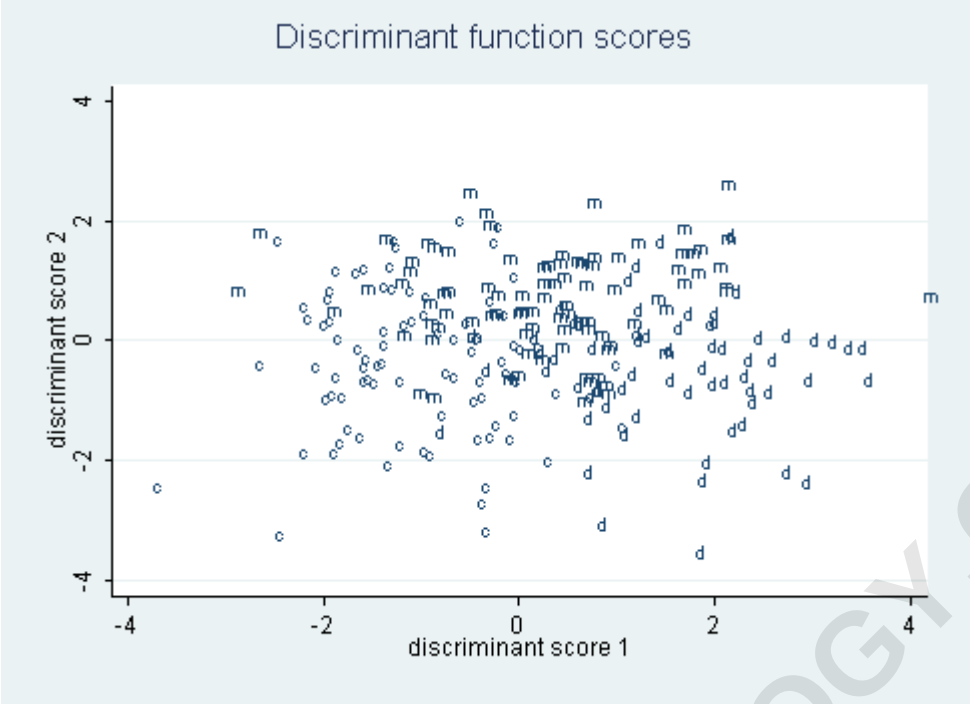

The discrimant functions are:

discriminant_score_1 = 0.517*conservative + 0.379*outdoor - 0.831*social.

discriminant_score_2 = 0.926*outdoor + 0.213*social - 0.291*conservative.

As you can see, the customer service employees tend to be at the more social (negative) end of dimension 1; the dispatchers are at the opposite end; the mechanics are in the middle. On dimension 2 the results are not as clear; however, the

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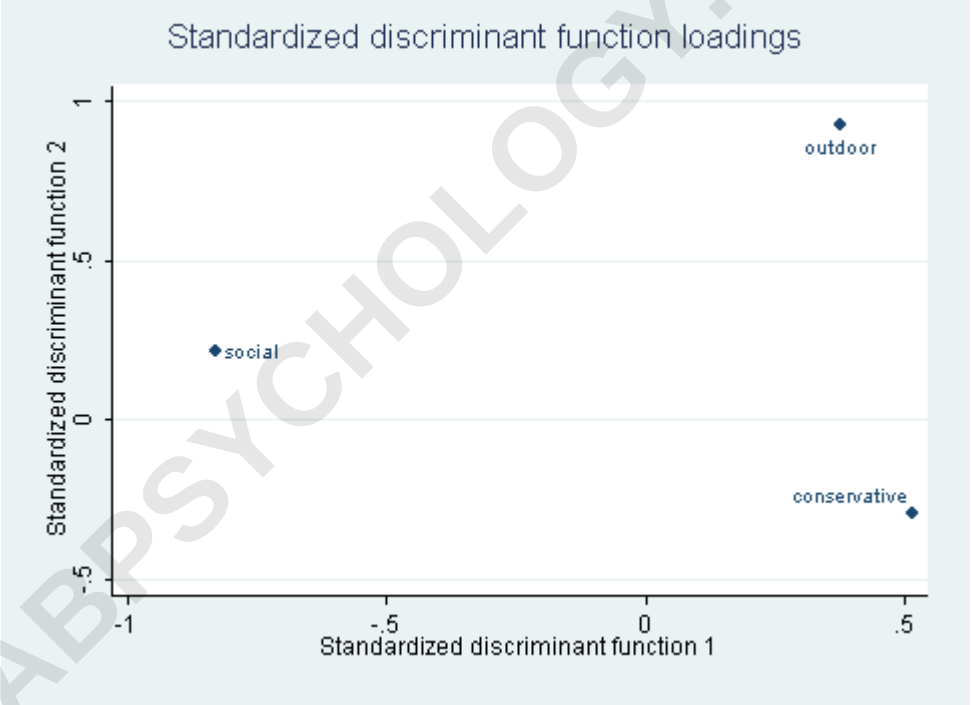
mechanics tend to be higher on the outdoor dimension and customer service employees and dispatchers are lower.

We can also plot the discriminant loadings for the variables onto the discriminant dimensions.



loadingplot

There is no surprise that the variable social is strong on the social dimension, i.e.,
it has a high negative loading, and the outdoor variable is high on the outdoor dimension.

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Things to consider

See also

References

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