Chapter 38
Loglinear Models for Assessing Incident Rates with Varying Incident Risks (12 Populations)

General Purpose

Data files that assess the effect of various predictors on frequency counts of morbidities/mortalities can be classified into multiple cells with varying incident risks (like, e.g., the incident risk of infarction). The underneath table gives an example:

In patients at risk of infarction with little soft drink consumption, and consumption of wine and other alcoholic beverages the incident risk of infarction equals 240/930 = 24.2 %, in those with lots of soft drinks, no wine, and no alcohol otherwise it is 285/1043 = 27.3 %.

soft drink (1 = little)	wine (0 = no)	alc beverages (0 = no)	infarcts number	Population number
1,00	1,00	1,00	240	993
1,00	1,00	,00	237	998
2,00	1,00	1,00	236	1016
2,00	1,00	,00	236	1011
3,00	1,00	1,00	221	1004
3,00	1,00	,00	221	1003
1,00	,00	1,00	270	939
1,00	,00	,00	269	940
2,00	,00	1,00	274	979
2,00	,00	,00	273	966
3,00	,00	1,00	284	1041
3,00	,00	,00	285	1043

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The general loglinear model using Poisson distributions (see Statistics applied to clinical studies 5th edition, Chap. 23, Poisson regression, pp 267–275, Springer Heidelberg Germany, 2012, from the same authors) is an appropriate method for statistical testing. This chapter is to assess this method, frequently used by banks and insurance companies but little by clinicians so far.

Primary Scientific Question

Can general loglinear modeling identify subgroups with significantly larger incident risks than other subgroups.

Example

The example in the above table will be applied. We wish to investigate the effect of soft drink, wine, and other alcoholic beverages on the risk of infarction. The data file is in extras.springer.com, and is entitled "loglinear". Start by opening the file in SPSS statistical software.

Command:

Analyze....Loglinear ....General Loglinear Analysis....Factor(s): enter softdrink, wine, other alc beverages....click "Data" in the upper textrow of your screen....click Weigh Cases....mark Weight cases by....Frequency Variable: enter "infarcts"....click OK....return to General Loglinear Analysis....Cell structure: enter "population".... Options ....mark Estimates....click Continue....Distribution of Cell Counts: mark Poisson....click OK.

Parameter estimates[a,b]

					95 % Confidence interval	
Parameter	Estimate	Std. Error	Z	Sig.	Lower bound	Upper bound
Constant	−1,513	,067	−22,496	,000	−1,645	−1,381
[softdrink = 1,00]	,095	,093	1,021	,307	−,088	,278
[softdrink = 2,00]	,053	,094	,569	,569	−,130	,237
[softdrink = 3,00]	0[c]					
[wine = ,00]	,215	,090	2,403	,016	,040	,391
[wine = 1,00]	0[c]					
[alcbeverages = ,00]	,003	,095	,029	,977	−,184	,189
[alcbeverages = 1,00]	0[c]					
[softdrink = 1,00] * [wine = ,00]	−,043	,126	−,345	,730	−,291	,204
[softdrink = 1,00] * [wine = 1,00]	0[c]					
[softdrink = 2,00] * [wine = ,00]	−,026	,126	−,209	,834	−,274	,221
[softdrink = 2,00] * [wine = 1,00]	0[c]					

(continued)

Parameter estimates[a,b]						
					95 % Confidence interval	
Parameter	Estimate	Std. Error	Z	Sig.	Lower bound	Upper bound
[softdrink = 3,00] * [wine = ,00]	0[c]					
[softdrink = 3,00] * [wine = 1,00]	0[c]					
[softdrink = 1,00] * [alcbeverages = ,00]	−,021	,132	−,161	,872	−,280	,237
[softdrink = 1,00] * [alcbeverages = 1,00]	0[c]					
[softdrink = 2,00] * [alcbeverages = ,00]	,003	,132	,024	,981	−,256	,262
[softdrink = 2,00] * [alcbeverages = 1,00]	0[c]					
[softdrink = 3,00] * [alcbeverages = ,00]	0[c]					
[softdrink = 3,00] * [alcbeverages = 1,00]	0[c]					
[wine = ,00] * [alcbeverages = ,00]	−,002	,127	−,018	,986	−,251	,246
[wine = ,00] * [alcbeverages = 1,00]	0[c]					
[wine = 1,00] * [alcbeverages = ,00]	0[c]					
[wine = 1,00] * [alcbeverages = 1,00]	0[c]					
[softdrink = 1,00] * [wine = ,00] * [alcbeverages = ,00]	,016	,178	,089	,929	−,334	,366
[softdrink = 1,00] * [wine = ,00] * [alcbeverages = 1,00]	0[c]					
[softdrink = 1,00] * [wine = 1,00] * [alcbeverages = ,00]	0[c]					
[softdrink = 1,00] * [wine = 1,0] * [alcbeverages = 1,00]	0[c]					
[softdrink = 2,00] * [wine = ,00] * [alcbeverages = ,00]	,006	,178	,036	,971	−,343	,356
[softdrink = 2,00] * [wine = ,00] * [alcbeverages = 1,00]	0[c]					
[softdrink = 2,00] * [wine = 1,00] * [alcbeverages = ,00]	0[c]					
[softdrink = 2,00] * [wine = 1,0]* [alcbeverages = 1,00]	0[c]					
[softdrink = 3,00] * [wine = ,00] * [alcbeverages = ,00]	0[c]					
[softdrink = 3,00] * [wine = ,00] * [alcbeverages = 1,00]	0[c]					
[softdrink = 3,00] * [wine = 1,00] * [alcbeverages = ,00]	0[c]					
[softdrink = 3,00] * [wine = 1,0] * [alcbeverages = 1,00]	0[c]					

[a]Model: Poisson

[b]Design: Constant + softdrink + wine + alcbeverages + softdrink * wine + softdrink * alcbeverages + wine * alcbeverages + softdrink * wine * alcbeverages

[c]This parameter is set to zero because it is redundant

The above pretty dull table gives some wonderful information. The soft drink classes 1 and 2 are not significantly different from zero. These classes have, thus, no greater risk of infarction than class 3. However, the regression coefficient of no wine is greater than zero at $p = 0.016$. No wine drinkers have a significantly greater risk of infarction than the wine drinkers have. No "other alcoholic beverages" did not protect from infarction better than the consumption of it. The three predictors did not display any interaction effects. This result would be in agreement with the famous French paradox.

Conclusion

Data files that assess the effect of various predictors on frequency counts of morbidities/mortalities can be classified into multiple cells with varying incident risks (like, e.g., the incident risk of infarction). The general loglinear model using Poisson distributions is an appropriate method for statistical testing. It can identify subgroups with significantly larger incident risks than other subgroups.

Note

More background, theoretical and mathematical information Poisson regression is given in Statistics applied to clinical studies 5th edition, Chap. 23, Poisson regression, pp 267–275, Springer Heidelberg Germany, 2012, from the same authors.