

The airport data

April 6, 2011

The data:

```
losangeles alaska ontime 497
losangeles alaska delayed 62
losangeles aw ontime 694
losangeles aw delayed 117
phoenix alaska ontime 221
phoenix alaska delayed 12
phoenix aw ontime 4840
phoenix aw delayed 415
sandiego alaska ontime 212
sandiego alaska delayed 20
sandiego aw ontime 383
sandiego aw delayed 65
sanfran alaska ontime 503
sanfran alaska delayed 102
sanfran aw ontime 320
sanfran aw delayed 129
seattle alaska ontime 1841
seattle alaska delayed 305
seattle aw ontime 201
seattle aw delayed 61
```

The SAS code and output:

```
options ls=80;

data airline;
  infile "airport.dat";
  input airport $ airline $ status $ freq;

proc catmod;
  weight freq;
  model airport*airline*status=_response_;
  loglin airport/airline/status;
```

```

proc catmod;
  weight freq;
  model airport*airline*status=_response_;
  loglin airport/airline/status @ 2;

run;

```

The CATMOD Procedure

| | | Data Summary | |
|-------------------|------------------------|-----------------|-------|
| Response | airport*airline*status | Response Levels | 20 |
| Weight Variable | freq | Populations | 1 |
| Data Set | AIRLINE | Total Frequency | 11000 |
| Frequency Missing | 0 | Observations | 20 |

Population Profiles

| Sample | Sample Size |
|--------|-------------|
| ----- | ----- |
| 1 | 11000 |

| Response Profiles | | | |
|-------------------|----------|---------|---------|
| Response | airport | airline | status |
| ----- | ----- | ----- | ----- |
| 1 | losangel | alaska | delayed |
| 2 | losangel | alaska | ontime |
| 3 | losangel | aw | delayed |
| 4 | losangel | aw | ontime |
| 5 | phoenix | alaska | delayed |
| 6 | phoenix | alaska | ontime |
| 7 | phoenix | aw | delayed |
| 8 | phoenix | aw | ontime |
| 9 | sandiego | alaska | delayed |
| 10 | sandiego | alaska | ontime |
| 11 | sandiego | aw | delayed |
| 12 | sandiego | aw | ontime |
| 13 | sanfran | alaska | delayed |
| 14 | sanfran | alaska | ontime |
| 15 | sanfran | aw | delayed |
| 16 | sanfran | aw | ontime |
| 17 | seattle | alaska | delayed |
| 18 | seattle | alaska | ontime |
| 19 | seattle | aw | delayed |
| 20 | seattle | aw | ontime |

Maximum Likelihood Analysis
Maximum likelihood computations converged.

| Maximum Likelihood Analysis of Variance | | | |
|---|----|------------|------------|
| Source | DF | Chi-Square | Pr > ChiSq |
| airport | 4 | 185.99 | <.0001 |
| airline | 1 | 118.66 | <.0001 |
| airport*airline | 4 | 1138.97 | <.0001 |
| status | 1 | 1487.23 | <.0001 |
| airport*status | 4 | 99.56 | <.0001 |
| airline*status | 1 | 29.09 | <.0001 |
| airport*airline*status | 4 | 3.26 | 0.5156 |

The CATMOD Procedure

| Maximum Likelihood Analysis of Variance | | | |
|---|----|------------|------------|
| Source | DF | Chi-Square | Pr > ChiSq |
| Likelihood Ratio | 0 | . | . |

Analysis of Maximum Likelihood Estimates

| Parameter | | Estimate | Standard Error |
|------------------------|-------------------------|----------|----------------|
| airport | losangel | 0.0782 | 0.0407 |
| | phoenix | 0.2671 | 0.0632 |
| | sandiego | -0.7132 | 0.0577 |
| | sanfran | 0.0366 | 0.0381 |
| airline | alaska | -0.2664 | 0.0245 |
| airport*airline | losangel alaska | 0.0241 | 0.0407 |
| | phoenix alaska | -1.3911 | 0.0632 |
| | sandiego alaska | -0.1762 | 0.0577 |
| | sanfran alaska | 0.3207 | 0.0381 |
| status | delayed | -0.9430 | 0.0245 |
| airport*status | losangel delayed | -0.0224 | 0.0407 |
| | phoenix delayed | -0.3994 | 0.0632 |
| | sandiego delayed | -0.0906 | 0.0577 |
| | sanfran delayed | 0.3170 | 0.0381 |
| airline*status | alaska delayed | -0.1319 | 0.0245 |
| airport*airline*status | losangel alaska delayed | 0.0566 | 0.0407 |
| | phoenix alaska delayed | 0.0177 | 0.0632 |
| | sandiego alaska delayed | -0.0149 | 0.0577 |
| | sanfran alaska delayed | -0.0399 | 0.0381 |

Analysis of Maximum Likelihood Estimates

| Parameter | | Chi-Square | Pr > ChiSq |
|-----------|----------|------------|------------|
| airport | losangel | 3.70 | 0.0543 |

| | | | |
|------------------------|-------------------------|---------|--------|
| | phoenix | 17.88 | <.0001 |
| | sandiego | 152.99 | <.0001 |
| | sanfran | 0.92 | 0.3367 |
| airline | alaska | 118.66 | <.0001 |
| airport*airline | losangel alaska | 0.35 | 0.5528 |
| | phoenix alaska | 484.92 | <.0001 |
| | sandiego alaska | 9.33 | 0.0022 |
| | sanfran alaska | 71.04 | <.0001 |
| status | delayed | 1487.23 | <.0001 |
| airport*status | losangel delayed | 0.30 | 0.5812 |
| | phoenix delayed | 39.97 | <.0001 |
| | sandiego delayed | 2.47 | 0.1161 |
| | sanfran delayed | 69.39 | <.0001 |
| airline*status | alaska delayed | 29.09 | <.0001 |
| airport*airline*status | losangel alaska delayed | 1.94 | 0.1639 |
| | phoenix alaska delayed | 0.08 | 0.7797 |
| | sandiego alaska delayed | 0.07 | 0.7958 |
| | sanfran alaska delayed | 1.10 | 0.2945 |

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Population Profiles

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| Response Profiles | | | |
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| Response | airport | airline | status |
| ----- | ----- | ----- | ----- |
| 1 | losangel | alaska | delayed |
| 2 | losangel | alaska | ontime |
| 3 | losangel | aw | delayed |
| 4 | losangel | aw | ontime |
| 5 | phoenix | alaska | delayed |
| 6 | phoenix | alaska | ontime |
| 7 | phoenix | aw | delayed |
| 8 | phoenix | aw | ontime |
| 9 | sandiego | alaska | delayed |
| 10 | sandiego | alaska | ontime |
| 11 | sandiego | aw | delayed |
| 12 | sandiego | aw | ontime |

| | | | |
|----|---------|--------|---------|
| 13 | sanfran | alaska | delayed |
| 14 | sanfran | alaska | ontime |
| 15 | sanfran | aw | delayed |
| 16 | sanfran | aw | ontime |
| 17 | seattle | alaska | delayed |
| 18 | seattle | alaska | ontime |
| 19 | seattle | aw | delayed |
| 20 | seattle | aw | ontime |

Maximum Likelihood Analysis
Maximum likelihood computations converged.

| Maximum Likelihood Analysis of Variance | | | |
|---|----|------------|------------|
| Source | DF | Chi-Square | Pr > ChiSq |
| airport | 4 | 231.19 | <.0001 |
| airline | 1 | 163.72 | <.0001 |
| airport*airline | 4 | 3225.58 | <.0001 |
| status | 1 | 2700.13 | <.0001 |
| airport*status | 4 | 246.27 | <.0001 |
| airline*status | 1 | 41.74 | <.0001 |
| Likelihood Ratio | 4 | 3.22 | 0.5223 |

The CATMOD Procedure

| Analysis of Maximum Likelihood Estimates | | | | | |
|--|------------------|----------|----------------|------------|------------|
| Parameter | | Estimate | Standard Error | Chi-Square | Pr > ChiSq |
| airport | losangel | 0.0670 | 0.0373 | 3.23 | 0.0723 |
| | phoenix | 0.2551 | 0.0388 | 43.29 | <.0001 |
| | sandiego | -0.7019 | 0.0508 | 191.26 | <.0001 |
| | sanfran | 0.0474 | 0.0352 | 1.82 | 0.1779 |
| airline | alaska | -0.2722 | 0.0213 | 163.72 | <.0001 |
| airport*airline | losangel alaska | -0.0164 | 0.0261 | 0.39 | 0.5303 |
| | phoenix alaska | -1.4049 | 0.0302 | 2165.96 | <.0001 |
| | sandiego alaska | -0.1618 | 0.0348 | 21.57 | <.0001 |
| | sanfran alaska | 0.3461 | 0.0287 | 145.07 | <.0001 |
| status | delayed | -0.9521 | 0.0183 | 2700.13 | <.0001 |
| airport*status | losangel delayed | -0.0335 | 0.0360 | 0.87 | 0.3520 |
| | phoenix delayed | -0.4110 | 0.0305 | 181.94 | <.0001 |
| | sandiego delayed | -0.0762 | 0.0487 | 2.44 | 0.1180 |
| | sanfran delayed | 0.3268 | 0.0343 | 90.68 | <.0001 |
| airline*status | alaska delayed | -0.1361 | 0.0211 | 41.74 | <.0001 |