Categorical Data Analysis
Lab material #5-2

```
data wash;
input treatmnt $ washblty $ count @@;
cards;
water low 27 water medium 14 water high 5
standard low 10 standard medium 17 standard high 26
super low 5 super medium 12 super high 50
;
run;

proc freq order=data;
weight count;
tables treatmnt*washblty / chisq cmh;
run;

data wash2;
set wash;
select(treatmnt);
when('water') u=0;
when('standard') u=1;
when('super') u=2;
end;
select(washblty);
when('low') v=1;
when('medium') v=2;
when('high') v=3;
end;
run;

proc genmod data=wash2 data=order;
class treatmnt washblty;
model count = treatmnt washblty treatmnt*washblty / dist=poisson link=log; /* saturated model */
run;
proc genmod data=wash2 data=order;
class treatmnt washblty;
model count = treatmnt washblty u*v / dist=poisson link=log;  /* reduced model : linear-by-linear model or Uniform a
run;
```

Output 1 Results

```
                    The FREQ Procedure

                Table of treatmnt by washblty

        treatmnt     washblty

        Frequency|
        Percent  |
        Row Pct  |
        Col Pct  |low      |medium  |high     |  Total
        ---------+--------+--------+--------+
        water    |     27 |     14 |      5 |     46
                 |  16.27 |   8.43 |   3.01 |  27.71
                 |  58.70 |  30.43 |  10.87 |
                 |  64.29 |  32.56 |   6.17 |
        ---------+--------+--------+--------+
        standard |     10 |     17 |     26 |     53
```

```
                    |   6.02 |  10.24 |  15.66 |  31.93
                    |  18.87 |  32.08 |  49.06 |
                    |  23.81 |  39.53 |  32.10 |
          ---------+--------+--------+--------+
           super    |      5 |     12 |     50 |     67
                    |   3.01 |   7.23 |  30.12 |  40.36
                    |   7.46 |  17.91 |  74.63 |
                    |  11.90 |  27.91 |  61.73 |
          ---------+--------+--------+--------+
           Total        42       43       81      166
                      25.30    25.90    48.80   100.00


             Statistics for Table of treatmnt by washblty


         Statistic                     DF       Value      Prob
         -------------------------------------------------------
         Chi-Square                     4     55.0879     <.0001
         Likelihood Ratio Chi-Square    4     58.0366     <.0001
         Mantel-Haenszel Chi-Square     1     50.6016     <.0001
         Phi Coefficient                       0.5761
         Contingency Coefficient               0.4992
         Cramer's V                            0.4073


                      Sample Size = 166


            Summary Statistics for treatmnt by washblty


       Cochran-Mantel-Haenszel Statistics (Based on Table Scores)


    Statistic    Alternative Hypothesis    DF       Value      Prob
    ---------------------------------------------------------------
        1        Nonzero Correlation        1     50.6016     <.0001
        2        Row Mean Scores Differ     2     52.7786     <.0001
        3        General Association        4     54.7560     <.0001


                    Total Sample Size = 166




                       The GENMOD Procedure

                       Model Information

             Data Set              WORK.WASH2
             Distribution              Poisson
             Link Function                 Log
             Dependent Variable          count


        Number of Observations Read          9
        Number of Observations Used          9


               Class Level Information


         Class        Levels    Values

         treatmnt          3    standard super water
         washblty          3    high low medium
```

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```
                      Criteria For Assessing Goodness Of Fit

            Criterion                    DF         Value      Value/DF

            Deviance                      0        0.0000          .
            Scaled Deviance               0        0.0000          .
            Pearson Chi-Square            .        0.0000          .
            Scaled Pearson X2             .        0.0000          .
            Log Likelihood                       357.3498
            Full Log Likelihood                  -20.3101
            AIC (smaller is better)               58.6202
            AICC (smaller is better)                  .
            BIC (smaller is better)               60.3953


      Algorithm converged.


                Analysis Of Maximum Likelihood Parameter Estimates

                                             Standard     Wald 95%              Wald
Parameter                         DF  Estimate   Error  Confidence Limits  Chi-Square

Intercept                          1    2.6391  0.2673   2.1152   3.1629      97.50
treatmnt          standard         1    0.1942  0.3609  -0.5132   0.9015       0.29
treatmnt          super            1   -0.1542  0.3934  -0.9252   0.6169       0.15
treatmnt          water            0    0.0000  0.0000   0.0000   0.0000        .
washblty          high             1   -1.0296  0.5210  -2.0507  -0.0085       3.91
washblty          low              1    0.6568  0.3293   0.0113   1.3023       3.98
washblty          medium           0    0.0000  0.0000   0.0000   0.0000        .
treatmnt*washblty standard high    1    1.4545  0.6072   0.2644   2.6446       5.74
treatmnt*washblty standard low     1   -1.1874  0.5170  -2.2007  -0.1741       5.27
treatmnt*washblty standard medium  0    0.0000  0.0000   0.0000   0.0000        .
treatmnt*washblty super    high    1    2.4567  0.6122   1.2569   3.6566      16.11
treatmnt*washblty super    low     1   -1.5322  0.6259  -2.7591  -0.3054       5.99
treatmnt*washblty super    medium  0    0.0000  0.0000   0.0000   0.0000        .
treatmnt*washblty water    high    0    0.0000  0.0000   0.0000   0.0000        .
treatmnt*washblty water    low     0    0.0000  0.0000   0.0000   0.0000        .
treatmnt*washblty water    medium  0    0.0000  0.0000   0.0000   0.0000        .
Scale                              0    1.0000  0.0000   1.0000   1.0000

                     Analysis Of Maximum Likelihood
                           Parameter Estimates


            Parameter                          Pr > ChiSq

            Intercept                            <.0001
            treatmnt          standard           0.5906
            treatmnt          super              0.6952
            treatmnt          water                 .
            washblty          high               0.0481
            washblty          low                0.0461
            washblty          medium                .
            treatmnt*washblty standard high      0.0166
            treatmnt*washblty standard low       0.0216
            treatmnt*washblty standard medium       .
            treatmnt*washblty super    high      <.0001
            treatmnt*washblty super    low       0.0144
            treatmnt*washblty super    medium       .
            treatmnt*washblty water    high         .
            treatmnt*washblty water    low          .
```

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```
              treatmnt*washblty  water     medium       .
              Scale


NOTE: The scale parameter was held fixed.




                          The GENMOD Procedure

                          Model Information

                 Data Set              WORK.WASH2
                 Distribution             Poisson
                 Link Function                Log
                 Dependent Variable         count


              Number of Observations Read         9
              Number of Observations Used         9



                     Class Level Information

              Class         Levels   Values

              treatmnt           3   standard super water
              washblty           3   high low medium



                  Criteria For Assessing Goodness Of Fit

              Criterion                DF         Value      Value/DF

              Deviance                  3        1.9138        0.6379
              Scaled Deviance           3        1.9138        0.6379
              Pearson Chi-Square        3        1.9558        0.6519
              Scaled Pearson X2         3        1.9558        0.6519
              Log Likelihood                    356.3929
              Full Log Likelihood              -21.2670
              AIC (smaller is better)           54.5340
              AICC (smaller is better)          96.5340
              BIC (smaller is better)           55.7174


       Algorithm converged.


            Analysis Of Maximum Likelihood Parameter Estimates

                                 Standard  Wald 95% Confidence     Wald
Parameter             DF  Estimate   Error       Limits       Chi-Square  Pr > ChiSq

Intercept              1    2.5703  0.2066    2.1653    2.9754     154.71    <.0001
treatmnt    standard   1   -1.7858  0.3444   -2.4609   -1.1108      26.89    <.0001
treatmnt    super      1   -4.0981  0.7445   -5.5574   -2.6389      30.30    <.0001
treatmnt    water      0    0.0000  0.0000    0.0000    0.0000        .        .
washblty    high       1   -0.6845  0.3029   -1.2783   -0.0907       5.11    0.0239
washblty    low        1    0.7007  0.2369    0.2363    1.1650       8.75    0.0031
washblty    medium     0    0.0000  0.0000    0.0000    0.0000        .        .
u*v                    1    1.0228  0.1632    0.7029    1.3428      39.26    <.0001
Scale                  0    1.0000  0.0000    1.0000    1.0000
```

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NOTE: The scale parameter was held fixed.