Solutions of session 9 questions

a)Calculate the Odds Ratios associated with the tables above.

```
. di (220*19)/(85*14)
3.512605
```

```
. di (220*11)/(63*14)
2.7437642
```

b) *Compare the output of the "mlogit" command to the output of the two "logit" commands.*

The estimated coefficients and standard erros are exactly the same

c) *What is the interpretation of the coefficients in the "mlogit" command output. Compare with the results of question a).*

P(ME=1| hist=0) / P(ME=0 | hist=0) = exp(β_{10}) = exp(-.9509763) = 0.386
P(ME=1| hist=1) / P(ME=0 | hist=1) = exp($\beta_{10}+\beta_{11}$) = exp(-.9509763+1.256358) = 1.357.
[P(ME=1| hist=1)/P(ME=0 | hist=1)]/[P(ME=1| hist=0)/P(ME=0 | hist=0)] = exp(1.256)=3.513

This result is the same with the OR produced by the first 2x2 table

P(ME=2| hist=0) / P(ME=0 | hist=0) = exp(β_{20}) = exp(-1.250493) = 0.286
P(ME=2| hist=1) / P(ME=0 | hist=1) = exp($\beta_{20}+\beta_{21}$) = exp(-1.250493+1.009331) = 0.786.
[P(ME=2| hist=1)/P(ME=0 | hist=1)]/[P(ME=2| hist=0)/P(ME=0 | hist=0)] = exp(1.009)=2.744

This result is the same with the OR produced by the second 2×2 table

d) *Calculate the OR and its SE in order to produce the relevant statistic and test whether OR=1.*

The odds ratio is $\hat{\Psi}=\frac{(85)(11)}{(63)(19)}=0.781$. . Its standard deviation is $\hat{\sigma}=\sqrt{\frac{1}{85}+\frac{1}{11}+\frac{1}{63}+\frac{1}{19}}=0.4137$.

The test statistic is $z=\frac{\ln(\hat{\Psi})}{\hat{\sigma}}=-0.597$, which is associated with a p value p=0.551. There is no significant difference between the two odds ratios.

```
. di 2*(1-norm(0.597))
.55050738
```

e) *Notice the relation between the chi-square statistics in the first two "`test`" commands and the z statistics in the previous "`mlogit`" command.*

The chi-square statistics of the first two Wald tests can be obtained as the squares of the z-statistics for the "`family history`" dummy variables.

```
. di 3.353^2
11.242609
```

```
. di 2.361^2
5.574321
```

f) *Calculate the likelihood-ratio test manually.*

The likelihood-test can be derived manually as $\lambda = -2(-402.599 - (-396.170)) = 12.86$.

```
. di chi2tail(2,12.86)
.00161245
```

g) *What is the conclusion of the above tests?*

History of breast cancer is a significant predictive factor with respect to the frequency of Mamograms.

h) *Try to interpret the coefficients of the `Idetc_2` and `Idetc_3` dummy variables in terms of ORs produced by appropriate sub-tables of the 3x3 table above.*

Each one of the four coefficients β_{11} ,β_{12}, β_{21}, β_{22}, can be interpreted as a log Odds Ratio of a 2×2 sub-table of the 3×3 main table. For example: `Idetc_2` (ME=1 vs ME=0)=β_{11}=0.706

```
. di exp(.7060506)
2.0259741
```

```
. tab ME detc if ME<2 & detc<3

     Mammograph |  Likely find cancer
     experience | Not likel  Somewhat  |     Total
----------------+----------------------+-----------
          Never |        13         77 |        90
Within one year |         1         12 |        13
----------------+----------------------+-----------
          Total |        14         89 |       103
```

```
. di (13*12)/(77*1)
2.025974
```

i) State the null hypotheses for the three "`test`" commands.

<u>Test 1</u>
H_0 : $\beta_{11} = 0$ and $\beta_{12} = 0$, p-value<0.001 .We reject the null hypothesis, thus we accept that $\beta_{11} \neq 0$ or $\beta_{12} \neq 0$.

<u>Test 2</u>
H_0 : $\beta_{21} = 0$ and $\beta_{22} = 0$, p-value=0.177 .We cannot reject the null hypothesis.
<u>Test 3</u>
H_0 : $\beta_{11} = \beta_{21}$ and $\beta_{12} = \beta_{22}$, p-value<0.045 .We reject the null hypothesis, thus we accept that $\beta_{11} \neq \beta_{12}$ or $\beta_{21} \neq \beta_{22}$. This means that there is a difference in the relationship between the two factors within the two levels of ME. This is consistent to the graph on page 6.

k) What is the interpretation of the "pb" coefficients?

The first `pb` coefficient equals the log Odds Ratio for ME=1 vs. ME=0 for one unit increase in `pb` score.

The second `pb` coefficient equals the log Odds Ratio for ME=2 vs. ME=0 for one unit increase in `pb` score.

l) Interpret the result of the previous test command and compare it with the graphical representation of the model.

The result of the test is not significant at the 5% level thus we cannot reject the null hypothesis ($\beta_{11} = \beta_{21}$). In terms of a graphical representation of this model this means that the angle between the two lines is not that big (or its standard error is not so small).

m) Compare the results of the above two approaches.

The results are in most cases close but not exactly the same.