PubH 7430 – Fall 2007

EXAM

This exam runs from 11:15 am until 12:30 pm. There are 12 questions (5 Application and 7 Concepts) plus 1 extra credit problem.

ANSWER ONLY 10 OF THE 12 QUESTIONS.

Each question is worth 10 points. Please write all your answers in two blue exam books: Application answers in one blue book, and Concepts and Extra Credit answers in another. In all questions, be sure to define any notation you introduce. All Application questions relate to the following data set.

Data: A large company which owns and manages nursing homes in the United States assessed how satisfied their nursing home residents were with their care. The company designed a survey with one question on satisfaction in each of the following ten areas: food services, pharmacy services, physician care, nursing care, recreational opportunities, visitation policies, administrative staffing, cleanliness of the building, general atmosphere, and transportation options. The answers for the ten areas were combined into one 'satisfaction score' which ranged continuously from 0 (lowest level of statisfaction) to 10 (highest level of satisfaction).

The company operates 3 nursing homes located in rural areas and 53 nursing homes located in urban areas. 8 residents from each of the company's 56 nursing homes were randomly selected to answer the survey. Upon completion, the resident's gender and a general health status score were also recorded. Gender is coded as female=1 and male=2. Higher health status scores indicate better health. Nursing home location is coded as rural=1 and urban=2. The company's management would like to know:

A. After controlling for nursing home location (urban vs. rural), on average, are female residents more satisfied or less satisfied with their care compared to male residents?

B. After controlling for nursing home location (urban vs. rural), does the effect of gender on satisfaction differ by health status? If so, how does it differ (in what direction, by how much)?

ANSWER ONLY 10 OF THE 12 QUESTIONS.

If you answer more than 10 questions,
we will grade the first 10 we find in your blue books.

APPLICATION

A subset of the data are printed on page 5 so you can see how the data are structured. On pages 5–8 you will find some exploratory data analysis summary statistics and plots. On pages 9–18 you will find model output. On page 19 you will find chi-square critical values. On pages 20–21 you will find some diagnostic plots.

1. Using the summary statistics and plots on pages 5–8 (and NOT yet using any model output), briefly describe what the data indicate about:

   (a) research question A, and

   (b) research question B,

   shown on page 1.

2. Using the summary statistics and plots on pages 5–8 (and NOT yet using any model output), consider what the data indicate about covariance structures:

   (a) How big (how many rows, how many columns) is the variance/covariance matrix Σ_i for these data? (i is for cluster i.) Explain how you arrived at your answer.

   (b) Is unstructured a reasonable structure to consider for Σ_i? Justify your answer with one reason why it is, or is not, reasonable.

   (c) Is compound symmetry a reasonable structure to consider? Justify your answer with one reason why it is, or is not, reasonable.

3. On pages 9–18 you will find the `PROC MIXED` output from four GLMs for these data. The models are labeled `COVARIANCE MODEL` #1 through `COVARIANCE MODEL` #4. Choose the best covariance structure for these data. Use likelihood ratio tests if possible; use AIC or BIC if likelihood ratios tests are not possible. Indicate your answer clearly, and show the computations that got you to your answer, but you do not need to write a paragraph explaining what you did. (You will need three or four comparisons to answer this question.)

4. Suppose we proceed with `COVARIANCE MODEL` #4. Provide an answer to question B posed by the management on page 1. Your answer needs to have complete sentences with statistical results described within the scientific context of the question. (Note that the management wants to know WHETHER as well as HOW the gender effect differs by health status score.)

5. Again suppose we proceed with `COVARIANCE MODEL` #4. Using all the plots and output shown, briefly describe what they indicate about:

   (a) variability in the fitted values compared to variability in the satisfaction scores,

   (b) the appropriateness of assuming a linear trend for health score, and

   (c) normality of the errors.

CONCEPTS

6. (a) We have discussed power several times in class. If we have a repeated measures dataset (either longitudinal or cluster correlated), and we mistakenly fit a model which does NOT account for the repeated measures, what does that usually do to our power to test the predictors of interest?

   (b) Explain the difference between an **age** effect and an **aging** effect on an outcome of interest (e.g., cardiovascular disease, or pick your own outcome of interest).

7. Consider again the Application data set and `COVARIANCE MODEL` #4. Suppose we were to test the gender by health status interaction with a likelihood ratio test. Write down:

   (a) how you would compute the likelihood ratio test statistic and its degrees of freedom,

   (b) the null hypothesis being tested (in words or in symbols), and

   (c) the estimation method you would need to use (just name it, do not write down any equations).

   Your answers must be very specific to get full credit.

8. Consider again the Application data set. Suppose the management was interested in the following question: 'After controlling for nursing home location (urban vs. rural), do nursing homes with higher proportions of female residents tend to report lower average satisfaction scores?' Briefly describe a different type of analysis you could do to answer this question.

9. Suppose we only had one nursing home, but we did a longitudinal study where we assessed satisfaction for each of 25 residents at several time points: month 1, month 2, month 4, and month 8.

   (a) How big is Σ_i now (number of rows, number of columns)? What is i indexing now?

   (b) Give one reason why Toeplitz would, or why Toeplitz would not, be a reasonable structure to consider.

   (c) How could we change the study design to make Toeplitz a more reasonable structure to consider?

10. Suppose we only had one nursing home, but we did a longitudinal study where we assessed satisfaction for each of 25 residents at several time points: month 1, month 2, month 4, and month 8. To keep this simple, assume that health status score and nursing home location are no longer of interest, but gender is.

    (a) If we were to fit a repeated measures ANOVA to these data, what covariate (predictor) effects would we need to include?

    (b) Which types of correlation structures can be fit using a repeated measures ANOVA analysis?

11. Pretend for the moment that Σ is known; we do not need to estimate it. For a GLM, using the fact that $\hat{\alpha} = (X'\Sigma^{-1}X)^{-1}X'\Sigma^{-1}Y$:

    (a) derive $E[\hat{\alpha}]$, and

    (b) derive $Var[\hat{\alpha}]$.

12. Consider the 'empirical' or 'sandwich' estimate of $Var[\hat{\alpha}]$:

$$(X'\hat{\Sigma}^{-1}X)^{-1}\left(\sum_{i=1}^{m} X_i'\,\hat{\Sigma}_i^{-1}\,\hat{\varepsilon}_i\,\hat{\varepsilon}_i'\,\hat{\Sigma}_i^{-1}X_i\right)(X'\,\hat{\Sigma}^{-1}X)^{-1}.$$

    Why do some statisticans prefer it over the usual estimate

$$(X'\hat{\Sigma}^{-1}X)^{-1}?$$

EXTRA CREDIT

1. (5 points) Consider again the Application data set and `COVARIANCE MODEL` #4. Find the fitted `R` and `RCORR` matrices in the model output. Using the `Covariance Parameter Estimates` table in the model output, show how SAS computes the values in the `R` and `RCORR` matrices. Specifically, show the computation of:

   (a) $Var[Y_{ij}]$ for person j in nursing home i which is located in an urban area, and

   (b) $Corr[Y_{ij}, Y_{ij\prime}]$ for persons j and $j\prime$ in nursing home i which is located in an urban area.

   Your answers must be very specific to get full credit.

The SAS System 22:00 Tuesday, October 16, 2007 1

Obs	homeid	personid	satisfaction	gender	hlthscore	location
1	1	1	7.14485	1	11.4107	2
2	1	2	6.41696	1	7.3688	2
3	1	3	7.36009	1	10.1948	2
4	1	4	6.97386	2	9.6124	2
5	1	5	6.67932	1	12.5528	2
6	1	6	7.46466	1	13.9226	2
7	1	7	8.02662	2	12.1057	2
8	1	8	7.12360	1	13.0002	2
9	2	1	5.85945	1	11.8027	2
10	2	2	6.41351	1	11.1565	2
11	2	3	6.89252	2	11.0128	2
12	2	4	6.63017	2	9.0568	2
13	2	5	6.67769	1	10.2468	2
14	2	6	6.19347	1	10.5480	2
15	2	7	5.77822	1	9.9834	2
16	2	8	6.61125	2	10.5770	2
17	3	1	7.05057	1	12.8144	2
18	3	2	6.28858	1	11.2855	2
19	3	3	6.69500	1	10.9325	2
20	3	4	6.08193	1	7.4300	2
21	3	5	7.10116	2	9.0040	2
22	3	6	7.34195	1	10.8438	2
23	3	7	7.52095	2	10.9044	2
24	3	8	6.97631	1	13.2915	2
25	4	1	7.48924	2	11.9405	1
26	4	2	6.69122	1	10.9565	1
27	4	3	7.10847	2	10.4655	1
28	4	4	6.79261	1	12.2312	1
29	4	5	7.41250	1	15.1007	1
30	4	6	6.63668	1	7.7708	1
31	4	7	6.33709	1	8.1888	1
32	4	8	7.10798	1	14.0042	1
33	5	1	7.13837	2	11.2347	1
34	5	2	6.49154	1	10.4215	1
35	5	3	7.16095	2	9.7255	1

The SAS System 21:53 Tuesday, October 16, 2007 1

The MEANS Procedure

Analysis Variable : satisfaction

gender	N Obs	N	Mean	Std Dev	Minimum	Maximum
Female	316	316	6.8698736	0.6478977	5.1943414	9.3375996
Male	132	132	7.5485630	0.6909791	5.8303343	8.8031500

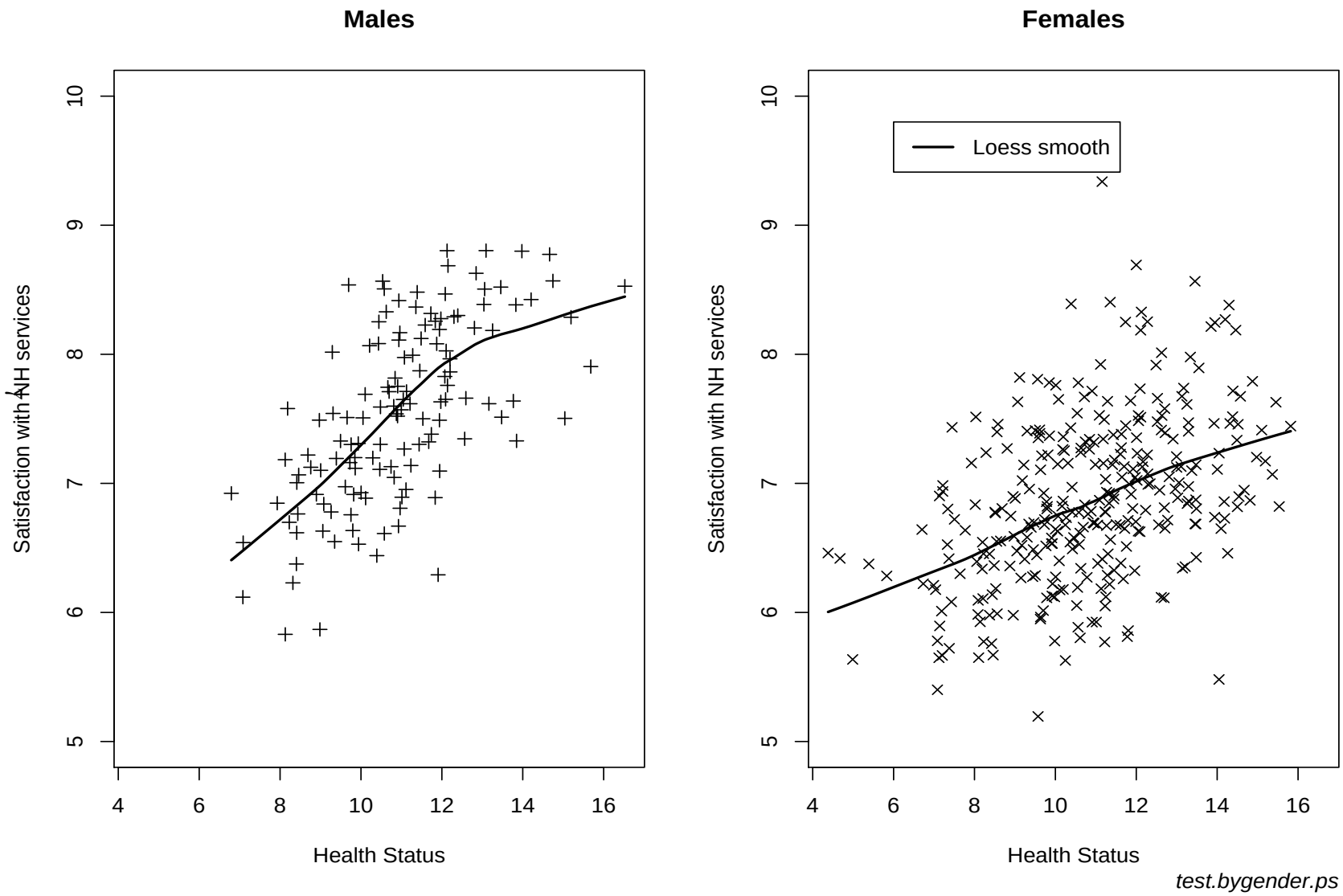
The SAS System 21:53 Tuesday, October 16, 2007 2

The MEANS Procedure

Analysis Variable : satisfaction

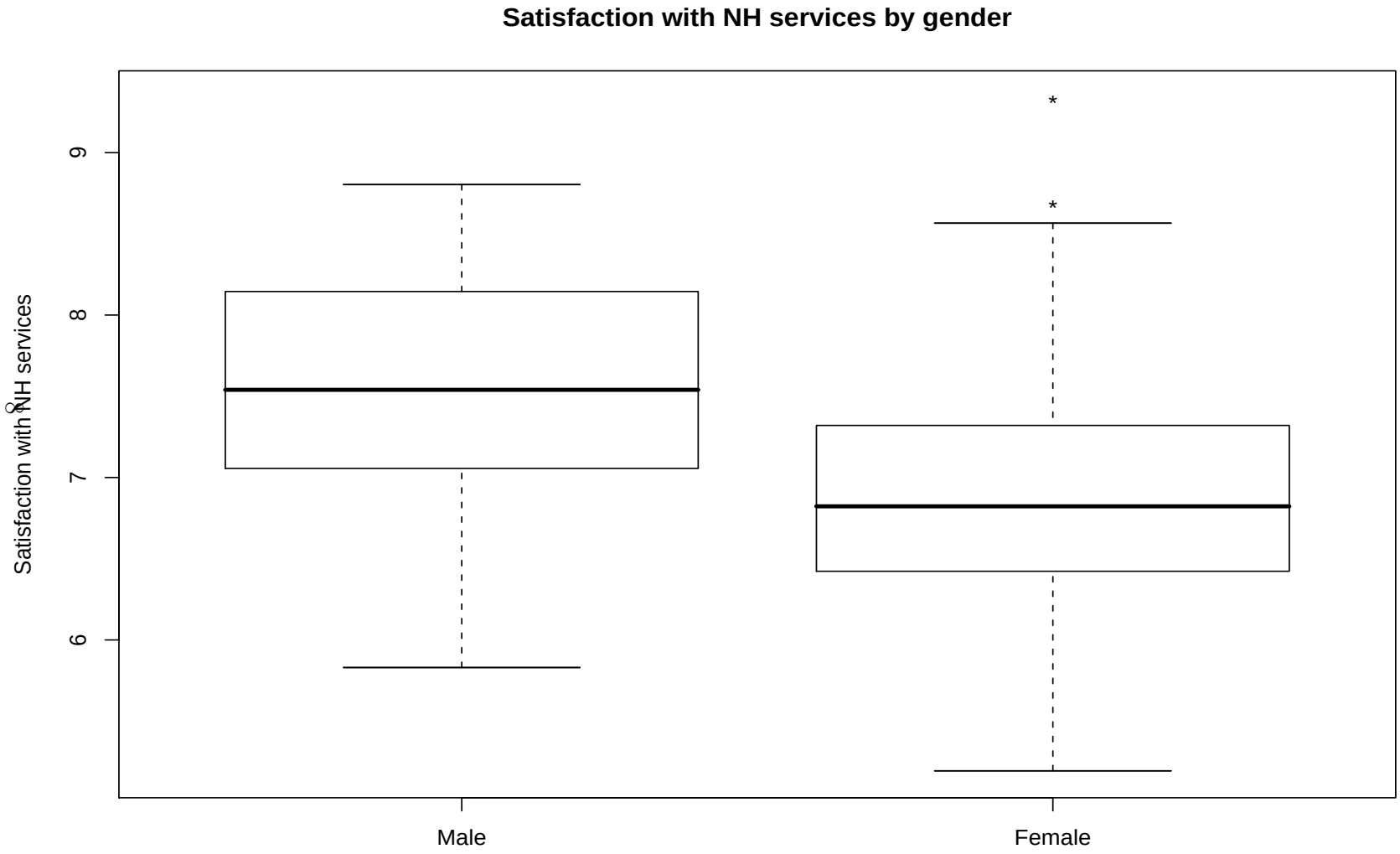
location	N Obs	N	Mean	Std Dev	Minimum	Maximum
Urban	424	424	7.0848766	0.7355830	5.1943414	9.3375996
Rural	24	24	6.8042788	0.5514778	5.7782173	8.0266195

SATISFACTION WITH NH SERVICES STUDY



test.bygender.ps

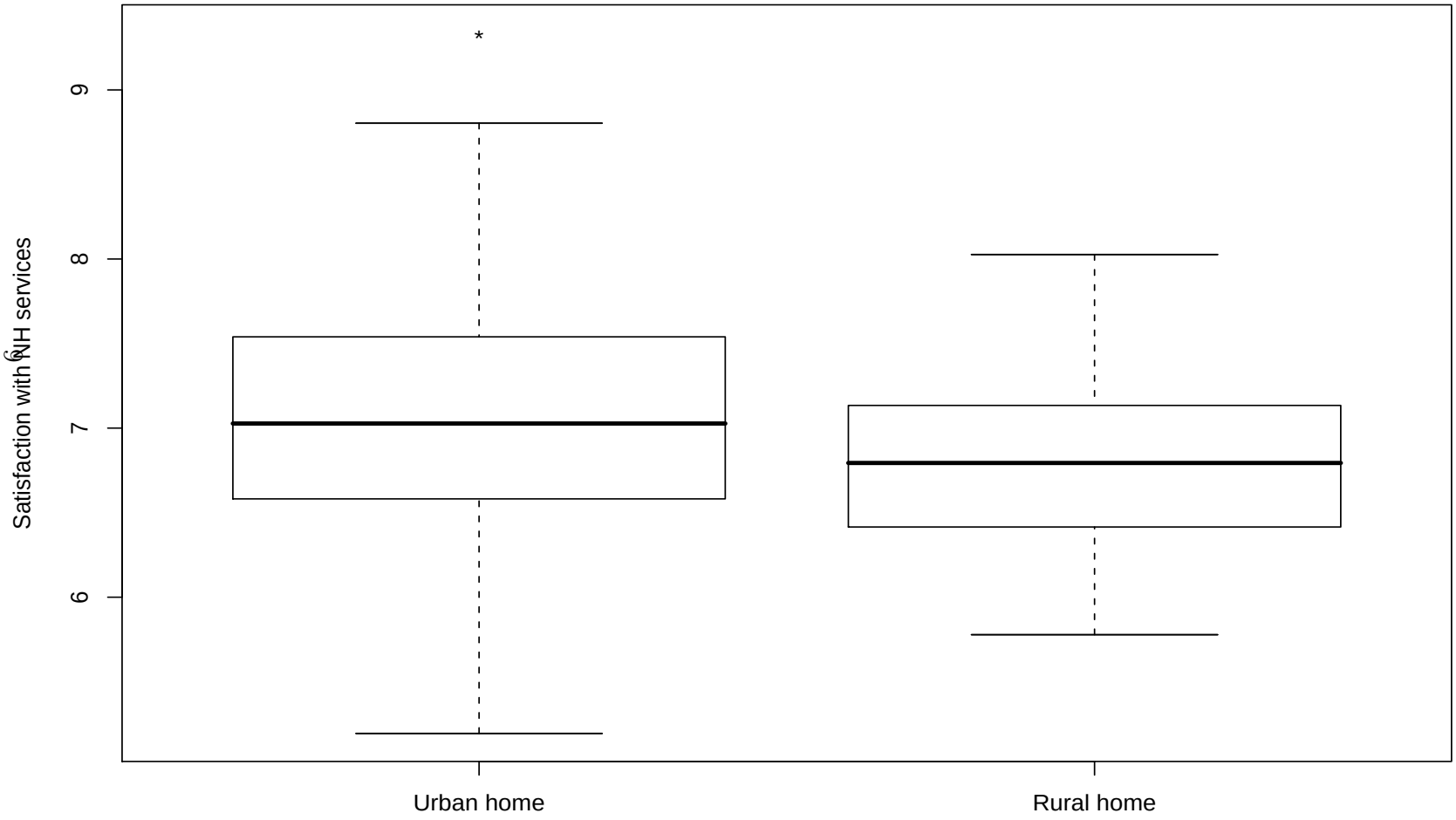
SATISFACTION WITH NH SERVICES STUDY



test.box.ps

SATISFACTION WITH NH SERVICES STUDY

Satisfaction with NH services by location of the home



test.homebox.ps

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################################################################################

COVARIANCE MODEL #1                              21:53 Tuesday, October 16, 2007   1

The Mixed Procedure

                  Model Information

Data Set                     WORK.DAT
Dependent Variable           satisfaction
Covariance Structure         Variance Components
Subject Effect               homeid
Estimation Method            REML
Residual Variance Method     Parameter
Fixed Effects SE Method      Model-Based
Degrees of Freedom Method    Between-Within


              Class Level Information

Class       Levels    Values

personid         8    1 2 3 4 5 6 7 8
homeid          56    1 2 3 4 5 6 7 8 9 10 11 12 13
                      14 15 16 17 18 19 20 21 22 23
                      24 25 26 27 28 29 30 31 32 33
                      34 35 36 37 38 39 40 41 42 43
                      44 45 46 47 48 49 50 51 52 53
                      54 55 56
gender           2    Female Male
location         2    Rural Urban


            Dimensions

Covariance Parameters             1
Columns in X                      8
Columns in Z                      0
Subjects                         56
Max Obs Per Subject               8


          Number of Observations

Number of Observations Read             448
Number of Observations Used             448
Number of Observations Not Used           0


                    Iteration History

Iteration    Evaluations    -2 Res Log Like       Criterion

        0              1       781.64856042
        1              1       781.64856042      0.00000000


                  Convergence criteria met.


The Mixed Procedure

                         Estimated R Matrix for homeid 1

 Row      Col1      Col2      Col3      Col4      Col5      Col6      Col7      Col8

   1    0.3215
   2              0.3215
   3                        0.3215
   4                                  0.3215
   5                                            0.3215
   6                                                      0.3215
   7                                                                0.3215
   8                                                                          0.3215
```

Estimated R Correlation Matrix for homeid 1

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	1.0000							
2		1.0000						
3			1.0000					
4				1.0000				
5					1.0000			
6						1.0000		
7							1.0000	
8								1.0000

Covariance Parameter Estimates

Cov Parm	Subject	Estimate
personid	homeid	0.3215

Fit Statistics

-2 Res Log Likelihood	781.6
AIC (smaller is better)	783.6
AICC (smaller is better)	783.7
BIC (smaller is better)	785.7

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
0	0.00	1.0000

Solution for Fixed Effects

Effect	gender	location	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			4.9323	0.3026	54	16.30	<.0001
gender	Female		0.5234	0.3438	52	1.52	0.1340
gender	Male		0	.	.	.	.
hlthscore			0.2399	0.02720	389	8.82	<.0001
hlthscore*gender	Female		-0.1082	0.03097	389	-3.49	0.0005
hlthscore*gender	Male		0	.	.	.	.
location		Rural	-0.2571	0.1191	54	-2.16	0.0354
location		Urban	0	.	.	.	.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
gender	1	52	2.32	0.1340
hlthscore	1	389	144.17	<.0001
hlthscore*gender	1	389	12.20	0.0005
location	1	54	4.66	0.0354

Least Squares Means

Effect	gender	Estimate	Standard Error	DF	t Value	Pr > |t|
gender	Female	6.7598	0.06198	52	109.06	<.0001
gender	Male	7.4133	0.07256	52	102.16	<.0001

Differences of Least Squares Means

Effect	gender	_gender	Estimate	Standard Error	DF	t Value	Pr > |t|
gender	Female	Male	-0.6534	0.05881	52	-11.11	<.0001

The Mixed Procedure

Model Information

Data Set	WORK.DAT
Dependent Variable	satisfaction
Covariance Structure	Compound Symmetry
Subject Effect	homeid
Estimation Method	REML
Residual Variance Method	Profile
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Between-Within

Class Level Information

Class	Levels	Values
personid	8	1 2 3 4 5 6 7 8
homeid	56	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56
gender	2	Female Male
location	2	Rural Urban

Dimensions

Covariance Parameters	2
Columns in X	8
Columns in Z	0
Subjects	56
Max Obs Per Subject	8

Number of Observations

Number of Observations Read	448
Number of Observations Used	448
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	781.64856042	
1	2	770.72803534	0.00000000

Convergence criteria met.

The Mixed Procedure

Estimated R Matrix for homeid 1

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	0.3224	0.03174	0.03174	0.03174	0.03174	0.03174	0.03174	0.03174
2	0.03174	0.3224	0.03174	0.03174	0.03174	0.03174	0.03174	0.03174
3	0.03174	0.03174	0.3224	0.03174	0.03174	0.03174	0.03174	0.03174
4	0.03174	0.03174	0.03174	0.3224	0.03174	0.03174	0.03174	0.03174
5	0.03174	0.03174	0.03174	0.03174	0.3224	0.03174	0.03174	0.03174
6	0.03174	0.03174	0.03174	0.03174	0.03174	0.3224	0.03174	0.03174
7	0.03174	0.03174	0.03174	0.03174	0.03174	0.03174	0.3224	0.03174

8	0.03174	0.03174	0.03174	0.03174	0.03174	0.03174	0.03174	0.3224

Estimated R Correlation Matrix for homeid 1

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	1.0000	0.09843	0.09843	0.09843	0.09843	0.09843	0.09843	0.09843
2	0.09843	1.0000	0.09843	0.09843	0.09843	0.09843	0.09843	0.09843
3	0.09843	0.09843	1.0000	0.09843	0.09843	0.09843	0.09843	0.09843
4	0.09843	0.09843	0.09843	1.0000	0.09843	0.09843	0.09843	0.09843
5	0.09843	0.09843	0.09843	0.09843	1.0000	0.09843	0.09843	0.09843
6	0.09843	0.09843	0.09843	0.09843	0.09843	1.0000	0.09843	0.09843
7	0.09843	0.09843	0.09843	0.09843	0.09843	0.09843	1.0000	0.09843
8	0.09843	0.09843	0.09843	0.09843	0.09843	0.09843	0.09843	1.0000

Covariance Parameter Estimates

Cov Parm	Subject	Estimate
CS	homeid	0.03174
Residual		0.2907

Fit Statistics

-2 Res Log Likelihood	770.7
AIC (smaller is better)	774.7
AICC (smaller is better)	774.8
BIC (smaller is better)	778.8

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
1	10.92	0.0010

Solution for Fixed Effects

Effect	gender	location	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			4.9529	0.2981	54	16.61	<.0001
gender	Female		0.5042	0.3367	52	1.50	0.1403
gender	Male		0	.	.	.	.
hlthscore			0.2377	0.02675	389	8.89	<.0001
hlthscore*gender	Female		-0.1060	0.03039	389	-3.49	0.0005
hlthscore*gender	Male		0	.	.	.	.
location		Rural	-0.2575	0.1550	54	-1.66	0.1024
location		Urban	0	.	.	.	.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
gender	1	52	2.24	0.1403
hlthscore	1	389	147.76	<.0001
hlthscore*gender	1	389	12.17	0.0005
location	1	54	2.76	0.1024

Least Squares Means

Effect	gender	Estimate	Standard Error	DF	t Value	Pr > |t|
gender	Female	6.7611	0.07925	52	85.31	<.0001
gender	Male	7.4099	0.08735	52	84.83	<.0001

Differences of Least Squares Means

Effect	gender	_gender	Estimate	Standard Error	DF	t Value	Pr > |t|
gender	Female	Male	-0.6489	0.05723	52	-11.34	<.0001

##

COVARIANCE MODEL #3 21:53 Tuesday, October 16, 2007 7

The Mixed Procedure

Model Information

Data Set	WORK.DAT
Dependent Variable	satisfaction
Covariance Structure	Variance Components
Subject Effect	homeid
Group Effect	location
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Between-Within

Class Level Information

Class	Levels	Values
personid	8	1 2 3 4 5 6 7 8
homeid	56	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56
gender	2	Female Male
location	2	Rural Urban

Dimensions

Covariance Parameters	2
Columns in X	8
Columns in Z	0
Subjects	56
Max Obs Per Subject	8

Number of Observations

Number of Observations Read	448
Number of Observations Used	448
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	781.64856042	
1	2	778.96991312	0.00000000

Convergence criteria met.

The Mixed Procedure

Estimated R Matrix for homeid 1

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	0.1922							
2		0.1922						

3			0.1922					
4				0.1922				
5					0.1922			
6						0.1922		
7							0.1922	
8								0.1922

Estimated R Correlation Matrix for homeid 1

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	1.0000							
2		1.0000						
3			1.0000					
4				1.0000				
5					1.0000			
6						1.0000		
7							1.0000	
8								1.0000

Estimated R Matrix for homeid 12

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	0.3286							
2		0.3286						
3			0.3286					
4				0.3286				
5					0.3286			
6						0.3286		
7							0.3286	
8								0.3286

Estimated R Correlation Matrix for homeid 12

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	1.0000							
2		1.0000						
3			1.0000					
4				1.0000				
5					1.0000			
6						1.0000		
7							1.0000	
8								1.0000

The Mixed Procedure

Covariance Parameter Estimates

Cov Parm	Subject	Group	Estimate
personid	homeid	location Rural	0.1922
personid	homeid	location Urban	0.3286

Fit Statistics

-2 Res Log Likelihood	779.0
AIC (smaller is better)	783.0
AICC (smaller is better)	783.0
BIC (smaller is better)	787.0

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
1	2.68	0.1017

Solution for Fixed Effects

Effect	gender	location	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			4.9201	0.3030	54	16.24	<.0001
gender	Female		0.5330	0.3439	52	1.55	0.1272
gender	Male		0	.	.	.	.
hlthscore			0.2408	0.02728	389	8.83	<.0001
hlthscore*gender	Female		-0.1089	0.03104	389	-3.51	0.0005
hlthscore*gender	Male		0	.	.	.	.
location		Rural	-0.2569	0.09392	54	-2.74	0.0084
location		Urban	0	.	.	.	.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
gender	1	52	2.40	0.1272
hlthscore	1	389	144.72	<.0001
hlthscore*gender	1	389	12.30	0.0005
location	1	54	7.48	0.0084

Least Squares Means

Effect	gender	Estimate	Standard Error	DF	t Value	Pr > |t|
gender	Female	6.7606	0.04994	52	135.38	<.0001
gender	Male	7.4117	0.06242	52	118.74	<.0001

Differences of Least Squares Means

Effect	gender	_gender	Estimate	Standard Error	DF	t Value	Pr > |t|
gender	Female	Male	-0.6511	0.05834	52	-11.16	<.0001

##

COVARIANCE MODEL #4 21:53 Tuesday, October 16, 2007 11

The Mixed Procedure

Model Information

Data Set	WORK.DAT
Dependent Variable	satisfaction
Covariance Structure	Compound Symmetry
Subject Effect	homeid
Group Effect	location
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Between-Within

Class Level Information

Class	Levels	Values
personid	8	1 2 3 4 5 6 7 8
homeid	56	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56
gender	2	Female Male
location	2	Rural Urban

Dimensions

Covariance Parameters	4
Columns in X	8
Columns in Z	0
Subjects	56
Max Obs Per Subject	8

Number of Observations

Number of Observations Read	448
Number of Observations Used	448
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	781.64856042	
1	2	761.28680096	0.00000025
2	1	761.28679440	0.00000000

Convergence criteria met.

The Mixed Procedure

Estimated R Matrix for homeid 1

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	0.2322	0.1308	0.1308	0.1308	0.1308	0.1308	0.1308	0.1308
2	0.1308	0.2322	0.1308	0.1308	0.1308	0.1308	0.1308	0.1308
3	0.1308	0.1308	0.2322	0.1308	0.1308	0.1308	0.1308	0.1308
4	0.1308	0.1308	0.1308	0.2322	0.1308	0.1308	0.1308	0.1308
5	0.1308	0.1308	0.1308	0.1308	0.2322	0.1308	0.1308	0.1308
6	0.1308	0.1308	0.1308	0.1308	0.1308	0.2322	0.1308	0.1308
7	0.1308	0.1308	0.1308	0.1308	0.1308	0.1308	0.2322	0.1308
8	0.1308	0.1308	0.1308	0.1308	0.1308	0.1308	0.1308	0.2322

Estimated R Correlation Matrix for homeid 1

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	1.0000	0.5634	0.5634	0.5634	0.5634	0.5634	0.5634	0.5634
2	0.5634	1.0000	0.5634	0.5634	0.5634	0.5634	0.5634	0.5634
3	0.5634	0.5634	1.0000	0.5634	0.5634	0.5634	0.5634	0.5634
4	0.5634	0.5634	0.5634	1.0000	0.5634	0.5634	0.5634	0.5634
5	0.5634	0.5634	0.5634	0.5634	1.0000	0.5634	0.5634	0.5634
6	0.5634	0.5634	0.5634	0.5634	0.5634	1.0000	0.5634	0.5634
7	0.5634	0.5634	0.5634	0.5634	0.5634	0.5634	1.0000	0.5634
8	0.5634	0.5634	0.5634	0.5634	0.5634	0.5634	0.5634	1.0000

Estimated R Matrix for homeid 12

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	0.3288	0.02749	0.02749	0.02749	0.02749	0.02749	0.02749	0.02749
2	0.02749	0.3288	0.02749	0.02749	0.02749	0.02749	0.02749	0.02749
3	0.02749	0.02749	0.3288	0.02749	0.02749	0.02749	0.02749	0.02749
4	0.02749	0.02749	0.02749	0.3288	0.02749	0.02749	0.02749	0.02749
5	0.02749	0.02749	0.02749	0.02749	0.3288	0.02749	0.02749	0.02749
6	0.02749	0.02749	0.02749	0.02749	0.02749	0.3288	0.02749	0.02749
7	0.02749	0.02749	0.02749	0.02749	0.02749	0.02749	0.3288	0.02749
8	0.02749	0.02749	0.02749	0.02749	0.02749	0.02749	0.02749	0.3288

Estimated R Correlation Matrix for homeid 12

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	1.0000	0.08359	0.08359	0.08359	0.08359	0.08359	0.08359	0.08359
2	0.08359	1.0000	0.08359	0.08359	0.08359	0.08359	0.08359	0.08359

3	0.08359	0.08359	1.0000	0.08359	0.08359	0.08359	0.08359	0.08359
4	0.08359	0.08359	0.08359	1.0000	0.08359	0.08359	0.08359	0.08359
5	0.08359	0.08359	0.08359	0.08359	1.0000	0.08359	0.08359	0.08359
6	0.08359	0.08359	0.08359	0.08359	0.08359	1.0000	0.08359	0.08359
7	0.08359	0.08359	0.08359	0.08359	0.08359	0.08359	1.0000	0.08359
8	0.08359	0.08359	0.08359	0.08359	0.08359	0.08359	0.08359	1.0000

The Mixed Procedure

Covariance Parameter Estimates

Cov Parm	Subject	Group	Estimate
Variance	homeid	location Rural	0.1014
CS	homeid	location Rural	0.1308
Variance	homeid	location Urban	0.3013
CS	homeid	location Urban	0.02749

Fit Statistics

-2 Res Log Likelihood	761.3
AIC (smaller is better)	769.3
AICC (smaller is better)	769.4
BIC (smaller is better)	777.4

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
3	20.36	0.0001

Solution for Fixed Effects

Effect	gender	location	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			4.9593	0.2947	54	16.83	<.0001
gender	Female		0.5108	0.3320	52	1.54	0.1300
gender	Male		0	.	.	.	.
hlthscore			0.2374	0.02655	389	8.94	<.0001
hlthscore*gender	Female		-0.1070	0.03009	389	-3.56	0.0004
hlthscore*gender	Male		0	.	.	.	.
location		Rural	-0.2573	0.2216	54	-1.16	0.2507
location		Urban	0	.	.	.	.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
gender	1	52	2.37	0.1300
hlthscore	1	389	149.51	<.0001
hlthscore*gender	1	389	12.65	0.0004
location	1	54	1.35	0.2507

Least Squares Means

Effect	gender	Estimate	Standard Error	DF	t Value	Pr > |t|
gender	Female	6.7598	0.1119	52	60.39	<.0001
gender	Male	7.4131	0.1174	52	63.12	<.0001

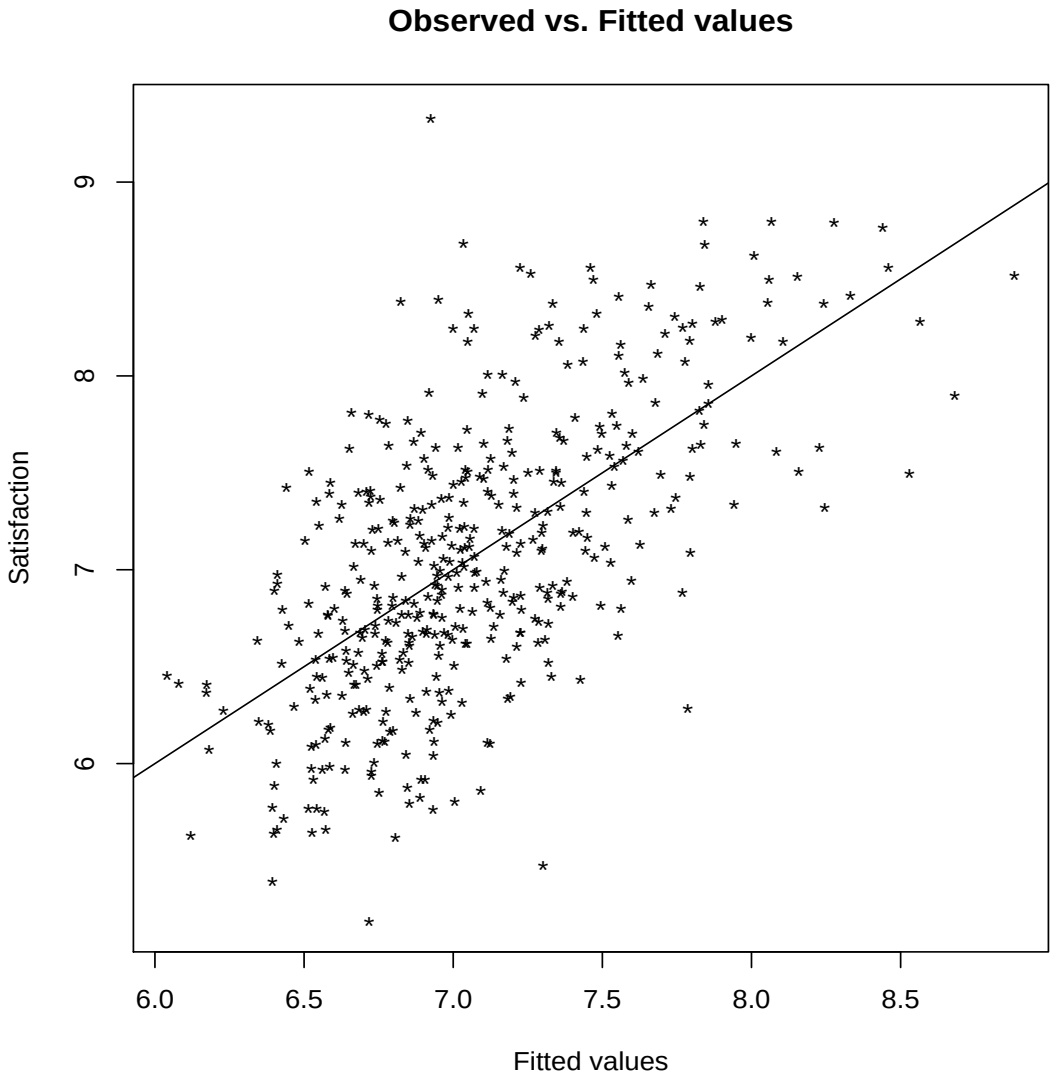
Differences of Least Squares Means

Effect	gender	_gender	Estimate	Standard Error	DF	t Value	Pr > |t|
gender	Female	Male	-0.6534	0.05522	52	-11.83	<.0001

0.95 quantile cut-points for hypothesis tests using $\alpha = 0.05$ for χ^2 distributions:

Distribution	Quantile cut-point
χ^2_1	3.84
χ^2_2	5.99
χ^2_3	7.81
χ^2_4	9.49
χ^2_5	11.07
χ^2_6	12.59
χ^2_7	14.07
χ^2_8	15.51
χ^2_9	16.92
χ^2_{10}	18.31
χ^2_{11}	19.68
χ^2_{12}	21.03
χ^2_{13}	22.36
χ^2_{14}	23.68
χ^2_{15}	25.00
χ^2_{16}	26.30
χ^2_{17}	27.59
χ^2_{18}	28.87
χ^2_{19}	30.14
χ^2_{20}	31.41
χ^2_{21}	32.67
χ^2_{22}	33.92
χ^2_{23}	35.17
χ^2_{24}	36.42
χ^2_{25}	37.65

You do not need to compute p-values for any likelihood ratio tests you report; just report whether or not they are significant at level $\alpha = 0.05$. I have not given you sufficient tables to compute a p-value.



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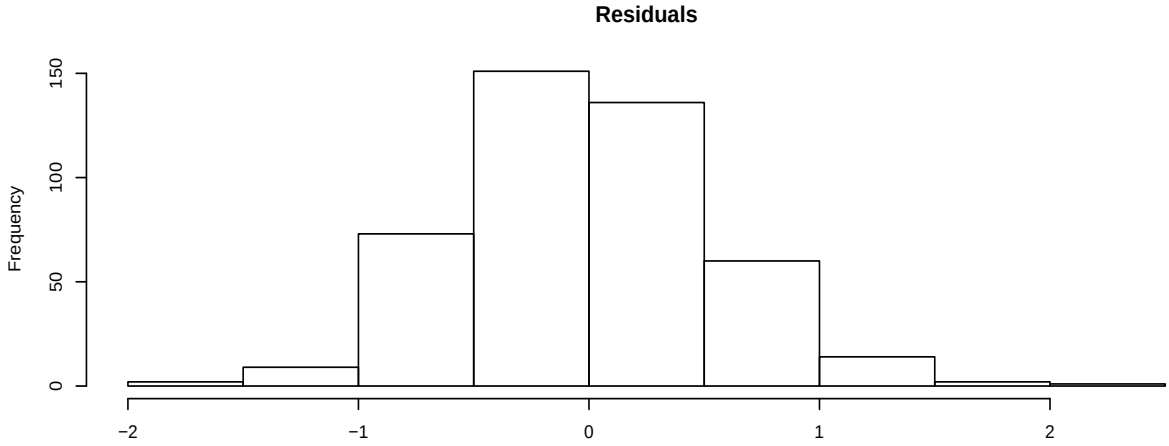
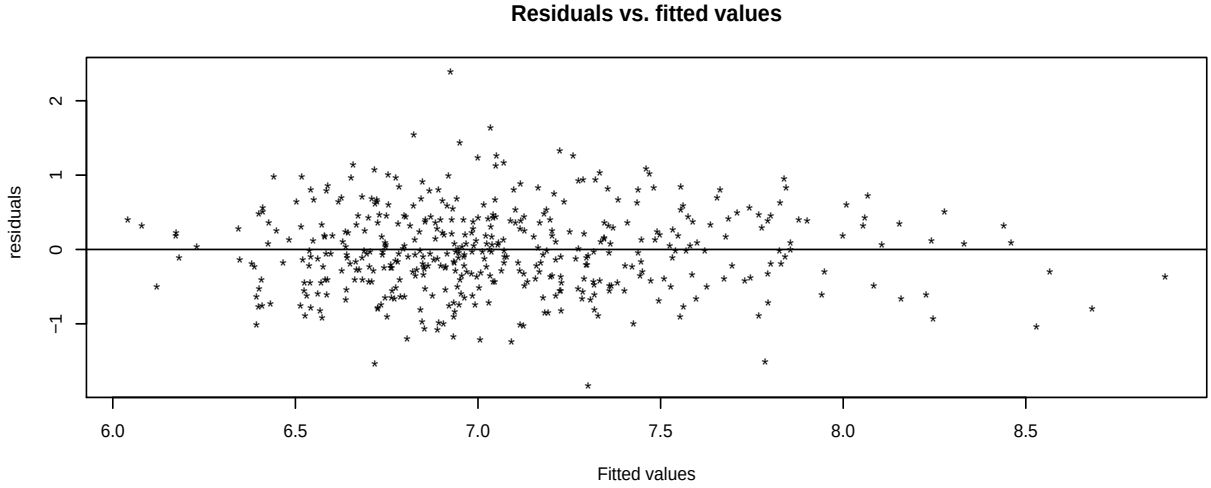
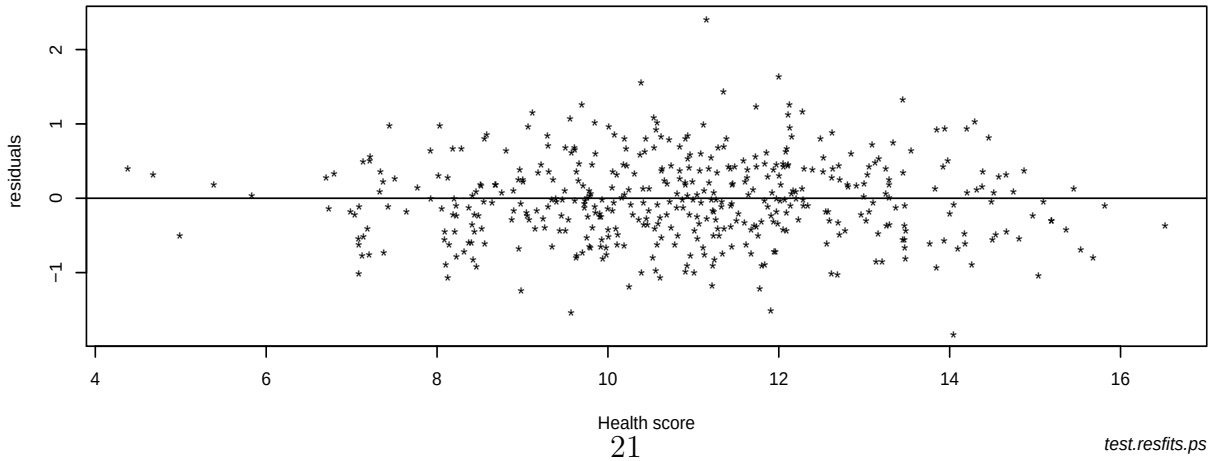
NURSING HOME SATISFACTION STUDY







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