

STA442s08 Final Exam Printouts

1. Mantids Study (6 pages)
2. Longitudinal IQ Study (10 pages)
3. Cartoon Study (5 pages)

Total = 22 pages
Including this cover page

Printout from the Mantids Study

```
/* finalmantids2.sas */
options linesize=79 pagesize=100 noovp formdlim='_';
title 'Mantids Data: STA442s08 Final Exam';

proc format;
  value sexfmt 0 = 'Male' 1 = 'Female';
  value dfmt 1 = '8cm' 2 = '13cm' 3 = '18cm';
run;

data mantids;
  infile 'mantids.data' firstobs=2; /* Skip the first line */
  input id1 Sex Order Predator Distance1 Calls1
        id2 Sex2 Order2 Predator2 Distance2 Calls2
        id3 Sex3 Order3 Predator3 Distance3 Calls3 ;
  label calls1 = 'Alarm Calls at 8cm'
        calls2 = 'Alarm Calls at 13cm'
        calls3 = 'Alarm Calls at 18cm';
  format sex sex2 sex3 sexfmt. distance1-distance3 dfmt.;
  combo = 10*sex + predator;
run;

proc glm;
  title2 'Analyze Alarm Calls at 18 cm';
  class sex predator;
  model calls3 = sex|predator;
  means sex|predator;
run;

proc freq;
  tables combo*(predator sex) / norow nocol nopercnt;
run;

proc glm;
  class combo;
  model calls3 = combo;
  contrast 'Mystery1' combo 1 1 1 1 -1 -1 -1 -1;
  contrast 'Mystery2' combo 1 -1 0 0 1 -1 0 0;
  contrast 'Mystery3' combo 1 0 -1 0 1 0 -1 0;
  contrast 'Mystery4' combo 1 0 0 -1 1 0 0 -1;
  contrast 'Mystery5' combo 0 1 -1 0 0 1 -1 0;
  contrast 'Mystery6' combo 0 1 0 -1 0 1 0 -1;
  contrast 'Mystery7' combo 0 0 1 -1 0 0 1 -1;
run;

proc iml;
  title3 'Table of critical values for all possible Scheffe tests';
  numdf = 7; /* Numerator degrees of freedom for initial test */
  dendf = 49; /* Denominator degrees of freedom for initial test */
  alpha = 0.05;
  critval = finv(1-alpha,numdf,dendf);
  zero = {0 0}; S_table = repeat(zero,numdf,1); /* Make empty matrix */
  /* Label the columns */
  namz = {"Number of Contrasts in followup test"
         " Scheffe Critical Value"}; attrib S_table colname=namz;
  do i = 1 to numdf;
    s_table(|i,1|) = i;
    s_table(|i,2|) = numdf/i * critval;
  end;
  reset noname; /* Makes output look nicer in this case */
  print "Initial test has" numdf " and " dendf "degrees of freedom."
        "Using significance level alpha = " alpha;
  print s_table;
run;
```

Mantids Data: STA442s08 Final Exam
 Analyze Alarm Calls at 18 cm

1

The GLM Procedure

Class Level Information

Class	Levels	Values
Sex	2	Female Male
Predator	4	1 2 3 4
Number of Observations Read		57
Number of Observations Used		57

Mantids Data: STA442s08 Final Exam
 Analyze Alarm Calls at 18 cm

2

16:23 Monday, April 7, 2008

The GLM Procedure

Dependent Variable: Calls3 Alarm Calls at 18cm

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	10756.62531	1536.66076	5.03	0.0002
Error	49	14980.35714	305.72157		
Corrected Total	56	25736.98246			

R-Square Coeff Var Root MSE Calls3 Mean
 0.417944 30.15549 17.48490 57.98246

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Sex	1	3665.427037	3665.427037	11.99	0.0011
Predator	3	7057.096030	2352.365343	7.69	0.0003
Sex*Predator	3	34.102246	11.367415	0.04	0.9903

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	3023.041378	3023.041378	9.89	0.0028
Predator	3	6810.205947	2270.068649	7.43	0.0003
Sex*Predator	3	34.102246	11.367415	0.04	0.9903

The GLM Procedure

Level of Sex	N	-----Calls3----- Mean	Std Dev
Female	28	49.8214286	21.7478029
Male	29	65.8620690	18.2262059

Level of Predator	N	-----Calls3----- Mean	Std Dev
1	17	55.0000000	18.4255258
2	15	42.0000000	17.5254916
3	11	66.0000000	18.7349940
4	14	72.4285714	19.3816499

Level of Sex	Level of Predator	N	-----Calls3----- Mean	Std Dev
Female	1	10	49.4000000	20.6677419
Female	2	7	33.1428571	18.9510648
Female	3	6	60.0000000	20.4254743
Female	4	5	61.8000000	18.6868938
Male	1	7	63.0000000	11.7331439
Male	2	8	49.7500000	12.6236739
Male	3	5	73.2000000	15.4012986
Male	4	9	78.3333333	18.0554701

The FREQ Procedure

Table of combo by Predator

combo	Predator				Total
Frequency	1	2	3	4	
1	7	0	0	0	7
2	0	8	0	0	8
3	0	0	5	0	5
4	0	0	0	9	9
11	10	0	0	0	10
12	0	7	0	0	7
13	0	0	6	0	6
14	0	0	0	5	5
Total	17	15	11	14	57

Table of combo by Sex

combo	Sex		Total
Frequency	Male	Female	
1	7	0	7
2	8	0	8
3	5	0	5
4	9	0	9
11	0	10	10
12	0	7	7
13	0	6	6
14	0	5	5
Total	29	28	57

Mantids Data: STA442s08 Final Exam
 Analyze Alarm Calls at 18 cm

5

The GLM Procedure

Class Level Information

Class	Levels	Values
combo	8	1 2 3 4 11 12 13 14
Number of Observations Read		57
Number of Observations Used		57

Mantids Data: STA442s08 Final Exam
 Analyze Alarm Calls at 18 cm

6

16:23 Monday, April 7, 2008

The GLM Procedure

Dependent Variable: Calls3 Alarm Calls at 18cm

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	10756.62531	1536.66076	5.03	0.0002
Error	49	14980.35714	305.72157		
Corrected Total	56	25736.98246			

R-Square	Coeff Var	Root MSE	Calls3 Mean
0.417944	30.15549	17.48490	57.98246

Source	DF	Type I SS	Mean Square	F Value	Pr > F
combo	7	10756.62531	1536.66076	5.03	0.0002

Source	DF	Type III SS	Mean Square	F Value	Pr > F
combo	7	10756.62531	1536.66076	5.03	0.0002

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
Mystery1	1	3023.041378	3023.041378	9.89	0.0028
Mystery2	1	1704.811289	1704.811289	5.58	0.0222
Mystery3	1	709.800000	709.800000	2.32	0.1340
Mystery4	1	1388.414900	1388.414900	4.54	0.0381
Mystery5	1	3988.516403	3988.516403	13.05	0.0007
Mystery6	1	5659.156771	5659.156771	18.51	<.0001
Mystery7	1	70.924590	70.924590	0.23	0.6322

Analyze Alarm Calls at 18 cm

Table of critical values for all possible Scheffe tests

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Initial test has 7 and 49 degrees of freedom.
Using significance level alpha = 0.05

Number of Contrasts in followup test	Scheffe Critical Value
1	15.422621
2	7.7113106
3	5.1408737
4	3.8556553
5	3.0845242
6	2.5704369
7	2.2032316

Printout from the Longitudinal IQ Study

```
/* finali2.sas */
options linesize=79 pagesize=500 noovp formdlim='- ' nodate;
title 'STA442s08 Final exam: Longitudinal IQ data on Adopted Children';

data smart;
  infile 'longiq.data' firstobs=5;
  input ameduc bmiq age2iq age4iq age8iq age13iq;
  label ameduc = "Adoptive Mother's Education"
        bmiq   = "Birth Mother's IQ";

proc reg simple corr;
  title2 'Multivariate Regression';
  model age2iq age4iq age8iq age13iq = ameduc bmiq;
  BothMV: mtest ameduc=bmiq=0;
  Educ: mtest ameduc=0;
  BirthmIQ: mtest bmiq=0;

data smart2; /* Make data set for proc mixed */
  infile 'longiq.data' firstobs=5;
  input ameduc bmiq age2iq age4iq age8iq age13iq;
  id = _n_;
  kidage = 2; kidiq = age2iq; output;
  kidage = 4; kidiq = age4iq; output;
  kidage = 8; kidiq = age8iq; output;
  kidage = 13; kidiq = age13iq; output;
  keep ameduc bmiq id kidage kidiq;

proc print;
  title2 'Take a look at data set smart2';

proc mixed;
  title2 'Within-cases ANCOVA';
  class kidage;
  model kidiq = ameduc bmiq kidage;
  repeated / type=un subject=id r;
  lsmeans kidage;
  contrast '2vs4' kidage 1 -1 0 0;
  contrast '2vs8' kidage 1 0 -1 0;
  contrast '2vs13' kidage 1 0 0 -1;
  contrast '4vs8' kidage 0 1 -1 0;
  contrast '4vs13' kidage 0 1 0 -1;
  contrast '8vs13' kidage 0 0 1 -1;
```

STA442s08 Final exam: Longitudinal IQ data on Adopted Children
Multivariate Regression

1

The REG Procedure

Number of Observations Read 62
Number of Observations Used 62

Descriptive Statistics

Variable	Sum	Mean	Uncorrected SS	Variance	Standard Deviation
Intercept	62.00000	1.00000	62.00000	0	0
ameduc	764.00000	12.32258	9930.00000	8.45161	2.90717
bmiq	5326.00000	85.90323	473080	255.07245	15.97099
age2iq	7169.00000	115.62903	839305	169.84373	13.03241
age4iq	6952.00000	112.12903	789846	169.26177	13.01006
age8iq	7098.00000	114.48387	823972	186.31941	13.64989
age13iq	6599.00000	106.43548	716771	236.11872	15.36616

Descriptive Statistics

Variable	Label
Intercept	Intercept
ameduc	Adoptive Mother's Education
bmiq	Birth Mother's IQ
age2iq	
age4iq	
age8iq	
age13iq	

Correlation

Variable	Label	ameduc	bmiq	age2iq
ameduc	Adoptive Mother's Education	1.0000	0.0702	-0.0950
bmiq	Birth Mother's IQ	0.0702	1.0000	0.0421
age2iq		-0.0950	0.0421	1.0000
age4iq		0.0145	0.2719	0.5087
age8iq		0.0229	0.3621	0.4764
age13iq		-0.0036	0.3798	0.2998

Correlation

Variable	Label	age4iq	age8iq	age13iq
ameduc	Adoptive Mother's Education	0.0145	0.0229	-0.0036
bmiq	Birth Mother's IQ	0.2719	0.3621	0.3798
age2iq		0.5087	0.4764	0.2998
age4iq		1.0000	0.6458	0.5394
age8iq		0.6458	1.0000	0.7739
age13iq		0.5394	0.7739	1.0000

The REG Procedure
 Model: MODEL1
 Dependent Variable: age2iq

Number of Observations Read 62
 Number of Observations Used 62

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	118.31114	59.15557	0.34	0.7126
Error	59	10242	173.59587		
Corrected Total	61	10360			

Root MSE 13.17558 R-Square 0.0114
 Dependent Mean 115.62903 Adj R-Sq -0.0221
 Coeff Var 11.39470

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value
Intercept	Intercept	1	117.63046	11.30323	10.41
ameduc	Adoptive Mother's Education	1	-0.44136	0.58171	-0.76
bmiq	Birth Mother's IQ	1	0.04001	0.10589	0.38

Parameter Estimates

Variable	Label	DF	Pr > t
Intercept	Intercept	1	<.0001
ameduc	Adoptive Mother's Education	1	0.4510
bmiq	Birth Mother's IQ	1	0.7069

The REG Procedure
 Model: MODEL1
 Dependent Variable: age4iq

Number of Observations Read 62
 Number of Observations Used 62

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	763.31841	381.65921	2.36	0.1038
Error	59	9561.64933	162.06185		
Corrected Total	61	10325			

Root MSE 12.73035 R-Square 0.0739
 Dependent Mean 112.12903 Adj R-Sq 0.0425
 Coeff Var 11.35331

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value
Intercept	Intercept	1	93.33771	10.92127	8.55
ameduc	Adoptive Mother's Education	1	-0.02073	0.56206	-0.04
bmiq	Birth Mother's IQ	1	0.22172	0.10231	2.17

Parameter Estimates

Variable	Label	DF	Pr > t
Intercept	Intercept	1	<.0001
ameduc	Adoptive Mother's Education	1	0.9707
bmiq	Birth Mother's IQ	1	0.0343

The REG Procedure
 Model: MODEL1
 Dependent Variable: age8iq

Number of Observations Read 62
 Number of Observations Used 62

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1490.06033	745.03016	4.45	0.0158
Error	59	9875.42354	167.38006		
Corrected Total	61	11365			

Root MSE 12.93754 R-Square 0.1311
 Dependent Mean 114.48387 Adj R-Sq 0.1016
 Coeff Var 11.30076

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value
Intercept	Intercept	1	88.03739	11.09902	7.93
ameduc	Adoptive Mother's Education	1	-0.01216	0.57120	-0.02
bmiq	Birth Mother's IQ	1	0.30961	0.10398	2.98

Parameter Estimates

Variable	Label	DF	Pr > t
Intercept	Intercept	1	<.0001
ameduc	Adoptive Mother's Education	1	0.9831
bmiq	Birth Mother's IQ	1	0.0042

The REG Procedure
 Model: MODEL1
 Dependent Variable: age13iq

Number of Observations Read 62
 Number of Observations Used 62

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	2090.83275	1045.41638	5.01	0.0098
Error	59	12312	208.68490		
Corrected Total	61	14403			

Root MSE 14.44593 R-Square 0.1452
 Dependent Mean 106.43548 Adj R-Sq 0.1162
 Coeff Var 13.57248

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value
Intercept	Intercept	1	76.84827	12.39306	6.20
ameduc	Adoptive Mother's Education	1	-0.16063	0.63780	-0.25
bmiq	Birth Mother's IQ	1	0.36747	0.11610	3.17

Parameter Estimates

Variable	Label	DF	Pr > t
Intercept	Intercept	1	<.0001
ameduc	Adoptive Mother's Education	1	0.8020
bmiq	Birth Mother's IQ	1	0.0025

The REG Procedure
 Model: MODEL1
 Multivariate Test: BothMV

Multivariate Statistics and F Approximations

S=2 M=0.5 N=27

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.80650199	1.59	8	112	0.1358
Pillai's Trace	0.19645764	1.55	8	114	0.1471
Hotelling-Lawley Trace	0.23625282	1.64	8	77.711	0.1280
Roy's Greatest Root	0.21953711	3.13	4	57	0.0214

NOTE: F Statistic for Roy's Greatest Root is an upper bound.
 NOTE: F Statistic for Wilks' Lambda is exact.

The REG Procedure
 Model: MODEL1
 Multivariate Test: Educ

Multivariate Statistics and Exact F Statistics

S=1 M=1 N=27

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.98277650	0.25	4	56	0.9113
Pillai's Trace	0.01722350	0.25	4	56	0.9113
Hotelling-Lawley Trace	0.01752534	0.25	4	56	0.9113
Roy's Greatest Root	0.01752534	0.25	4	56	0.9113

The REG Procedure
 Model: MODEL1
 Multivariate Test: BirthmIQ

Multivariate Statistics and Exact F Statistics

S=1 M=1 N=27

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.82240717	3.02	4	56	0.0250
Pillai's Trace	0.17759283	3.02	4	56	0.0250
Hotelling-Lawley Trace	0.21594271	3.02	4	56	0.0250
Roy's Greatest Root	0.21594271	3.02	4	56	0.0250

Obs	ameduc	bmiq	id	kidage	kidiq
1	10	100	1	2	120
2	10	100	1	4	115
3	10	100	1	8	109
4	10	100	1	13	106
5	10	71	2	2	131
6	10	71	2	4	109
7	10	71	2	8	113
8	10	71	2	13	95
9	14	89	3	2	126
10	14	89	3	4	115
11	14	89	3	8	113
12	14	89	3	13	90

Skipping the rest of the proc print output

The Mixed Procedure

Model Information

Data Set	WORK.SMART2
Dependent Variable	kidiq
Covariance Structure	Unstructured
Subject Effect	id
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
kidage	4	2 4 8 13

Dimensions

Covariance Parameters	10
Columns in X	7
Columns in Z	0
Subjects	62
Max Obs Per Subject	4

Number of Observations

Number of Observations Read	248
Number of Observations Used	248
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	1975.69060092	
1	2	1873.18504051	0.00000001
2	1	1873.18503177	0.00000000

Convergence criteria met.

Estimated R Matrix for Subject 1

Row	Col1	Col2	Col3	Col4
1	178.81	86.5124	80.5904	52.8122
2	86.5124	160.83	101.84	91.9042
3	80.5904	101.84	169.05	141.99
4	52.8122	91.9042	141.99	212.71

Covariance Parameter Estimates

Cov Parm	Subject	Estimate
UN(1,1)	id	178.81
UN(2,1)	id	86.5124
UN(2,2)	id	160.83
UN(3,1)	id	80.5904
UN(3,2)	id	101.84
UN(3,3)	id	169.05
UN(4,1)	id	52.8122
UN(4,2)	id	91.9042
UN(4,3)	id	141.99
UN(4,4)	id	212.71

Fit Statistics

-2 Res Log Likelihood	1873.2
AIC (smaller is better)	1893.2
AICC (smaller is better)	1894.1
BIC (smaller is better)	1914.5

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
9	102.51	<.0001

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
ameduc	1	59	0.19	0.6646
bmiq	1	59	5.56	0.0217
kidage	3	59	14.23	<.0001

Contrasts

Label	Num DF	Den DF	F Value	Pr > F
2vs4	1	59	4.56	0.0369
2vs8	1	59	0.44	0.5119
2vs13	1	59	18.33	<.0001
4vs8	1	59	2.72	0.1041
4vs13	1	59	10.59	0.0019
8vs13	1	59	41.07	<.0001

Least Squares Means

Effect	kidage	Estimate	Standard Error	DF	t Value	Pr > t
kidage	2	115.63	1.6983	59	68.09	<.0001
kidage	4	112.13	1.6106	59	69.62	<.0001
kidage	8	114.48	1.6512	59	69.33	<.0001
kidage	13	106.44	1.8522	59	57.46	<.0001

Printout from the Cartoon Study

```
/******finalcartoon.sas *****/
options linesize=79 pagesize=500 noovp formdlim='-' nodate;
title 'STA442/1008 Final Exam Cartoon';
proc format; /* value labels used in data step below */
  value cfmt 0 = 'Black & White' 1 = 'Colour';
  value efmt 0 = 'Pre-professional' 1 = 'Professional' 2 = 'Student';
  value lfmt 1 = 'Hospital A ' 2 = 'Hospital B'
           3 = 'Hospital C' 4 = 'Penn State';
data disney;
  infile 'cartoon.data';
  input id colour educ location otis cartoon1 reall1 cartoon2 real2;
  time = 1; type = 'Real'; memory = reall1; output;
  time = 1; type = 'Cartoon'; memory = cartoon1; output;
  time = 2; type = 'Real'; memory = real2; output;
  time = 2; type = 'Cartoon'; memory = cartoon2; output;

  label
    colour = 'Colour versus Black & white'
    educ = 'Education'
    location = 'Where did respondent come from?'
    otis = 'Otis Mental Ability Test'
    cartoon1 = 'Cartoon test score at time 1'
    reall1 = 'Realistic test score at time 1'
    cartoon2 = 'Cartoon test score at time 2'
    real2 = 'Realistic test score at time 2'
    memory = 'Recall of training materials'
    type = 'Training materials: Cartoon versus realistic ';
  format colour cfmt.;
  format educ efmt.;
  format location lfmt.;

proc print;
  var id otis memory colour educ time type;

proc mixed;
  title2 'Proc Mixed repeated measures';
  class colour educ time type;
  model memory = otis colour|educ|time|type;
  repeated / type=un subject=id r=1;
  lsmeans colour educ time type; /* Look at marginal means. */
```

Here's the proc print output for just the first three subjects.

Obs	id	otis	memory	colour	educ	time	type
STA442/1008 Final Exam Cartoon 1							
1	1	107	4	Black & White	Pre-professional	1	Real
2	1	107	4	Black & White	Pre-professional	1	Cart
3	1	107	.	Black & White	Pre-professional	2	Real
4	1	107	.	Black & White	Pre-professional	2	Cart
5	2	106	9	Black & White	Pre-professional	1	Real
6	2	106	9	Black & White	Pre-professional	1	Cart
7	2	106	5	Black & White	Pre-professional	2	Real
8	2	106	6	Black & White	Pre-professional	2	Cart
9	3	94	2	Black & White	Pre-professional	1	Real
10	3	94	4	Black & White	Pre-professional	1	Cart
11	3	94	0	Black & White	Pre-professional	2	Real
12	3	94	3	Black & White	Pre-professional	2	Cart

STA442/1008 Final Exam Cartoon 3
Proc Mixed repeated measures

The Mixed Procedure

Model Information

Data Set	WORK.DISNEY
Dependent Variable	memory
Covariance Structure	Unstructured
Subject Effect	id
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
colour	2	Black & White Colour
educ	3	Pre-professional Professional Student
time	2	1 2
type	2	Cart Real

Dimensions

Covariance Parameters	10
Columns in X	109
Columns in Z	0
Subjects	179
Max Obs Per Subject	4

Number of Observations

Number of Observations Read	716
Number of Observations Used	566
Number of Observations Not Used	150

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	2349.63399715	
1	2	2108.95154509	0.00005118
2	1	2108.92243696	0.00000005
3	1	2108.92240688	0.00000000

Convergence criteria met.

Estimated R Matrix
for Subject 1

Row	Col1	Col2
1	4.1418	2.8590
2	2.8590	3.5775

Covariance Parameter Estimates

Cov Parm	Subject	Estimate
UN(1,1)	id	4.1418
UN(2,1)	id	2.8590
UN(2,2)	id	3.5775
UN(3,1)	id	2.2846
UN(3,2)	id	1.7014
UN(3,3)	id	3.8344
UN(4,1)	id	2.0420
UN(4,2)	id	2.1181
UN(4,3)	id	2.3174
UN(4,4)	id	3.8831

Fit Statistics

-2 Res Log Likelihood	2108.9
AIC (smaller is better)	2128.9
AICC (smaller is better)	2129.3
BIC (smaller is better)	2160.8

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
9	240.71	<.0001

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
otis	1	172	82.57	<.0001
colour	1	172	1.68	0.1961
educ	2	172	2.04	0.1337
colour*educ	2	172	0.41	0.6662
time	1	172	155.12	<.0001
colour*time	1	172	1.57	0.2113
educ*time	2	172	1.31	0.2715
colour*educ*time	2	172	3.20	0.0434
type	1	172	51.07	<.0001
colour*type	1	172	0.01	0.9213
educ*type	2	172	0.86	0.4260
colour*educ*type	2	172	1.16	0.3146
time*type	1	172	0.04	0.8495
colour*time*type	1	172	0.74	0.3894
educ*time*type	2	172	1.00	0.3693
colou*educ*time*type	2	172	1.38	0.2538

Least Squares Means

Training materials:		Colour versus		Education	time	Estimate	Standard Error
Effect	realistic	Black & white	Black & white				
colour			Black & White			5.2996	0.1860
colour			Colour			4.9564	0.1898
educ				Pre-professional		4.9517	0.2666
educ				Professional		4.8954	0.2465
educ				Student		5.5368	0.2186
time					1	6.0874	0.1397
time					2	4.1686	0.1673
type	Cart					5.5359	0.1432
type	Real					4.7202	0.1473

Least Squares Means

Training materials:		Colour versus		Education	time	DF	t Value
Effect	realistic	Black & white	Black & white				
colour			Black & White			172	28.49
colour			Colour			172	26.11
educ				Pre-professional		172	18.57
educ				Professional		172	19.86
educ				Student		172	25.33
time					1	172	43.57
time					2	172	24.91
type	Cart					172	38.67
type	Real					172	32.05

Least Squares Means

Training materials:		Colour versus		Education	time	Pr > t
Effect	realistic	Black & white	Black & white			
colour			Black & White			<.0001
colour			Colour			<.0001
educ				Pre-professional		<.0001
educ				Professional		<.0001
educ				Student		<.0001
time					1	<.0001
time					2	<.0001
type	Cart					<.0001
type	Real					<.0001