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Homework 3

Problem 1

To investigate the effects of different regimens on the age at which children walk, newborn children were randomly assigned to one of four treatment groups: active exercise; passive exercise; no exercise; or an 8-week control group. Infants in the active- exercise group received walking and placing stimulation four times a day for eight weeks, infants in the passive-exercise group received an equal amount of gross motor stimulation, infants in the no-exercise group were tested along with the first two groups at weekly intervals, and the eight-week control group consisted of infants observed only at 8 weeks of age to control for possible effects of repeated examination. The response variable was age (in months) at which the infant first walked. The data is as follows:

Distribution of Ages (in Months) at which Infants First Walked Alone

Active Group	Passive Group	No-Exercise Group	Eight-Week Control Group
9.00	11.00	11.50	13.25
9.50	12.00	12.00	11.50
9.75	10.00	10.00	12.00
10.00	11.75	11.50	13.50
10.00	10.50	13.25	11.50
9.50	15.00	13.00	13.35

Is there evidence to suggest that certain regimens are better than others?

Hypothesis

H_0 – The mean average of age in months that an infant walks is the same across activity levels considered in our independent sample of groups.
H_1 – The mean average of age in months that an infant walks is not the same across activity levels and activity level has a positive or negative effect on the mean average time that infants walk (earlier or later).

Assumptions

- Groups being considered are independent and categorical consisting of more than two.

- The dependent variable (activity level) is continuous (interval or ratio) and affects the time at which an infant will walk.
- The sample of new boards in comes from a simple random sample
- Random sample of considered activity levels is normally distributed for each category of the independent variables.
- Equality of variances between the independent groups.
- Independence of cases.

We can run a one-way Anova to compare the means with the stated assumptions.

Results

ANOVA

Activity Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	28.286	3	9.429	6.729	.003
Within Groups	28.023	20	1.401		
Total	56.309	23			

Descriptives

Activity Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Active	6	9.6250	.37914	.15478	9.2271	10.0229	9.00	10.00
Passive	6	11.7083	1.77776	.72577	9.8427	13.5740	10.00	15.00
No-Excercise	6	11.8750	1.18057	.48197	10.6361	13.1139	10.00	13.25
Eight-Week Control Group	6	12.5167	.95219	.38873	11.5174	13.5159	11.50	13.50
Total	24	11.4313	1.56468	.31939	10.7705	12.0920	9.00	15.00

Robust Tests of Equality of Means

Activity Score

	Statistic[a]	df1	df2	Sig.
Welch	19.220	3	9.588	.000
Brown-Forsythe	6.729	3	12.296	.006

a. Asymptotically F distributed.

Multiple Comparisons

Activity Score

Tukey HSD

(I) Activity Group	(J) Activity Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Active	Passive	-2.08333*	.68341	.030	-3.9962	-.1705
	No-Excercise	-2.25000*	.68341	.018	-4.1628	-.3372
	Eight-Week Control Group	-2.89167*	.68341	.002	-4.8045	-.9788
Passive	Active	2.08333*	.68341	.030	.1705	3.9962
	No-Excercise	-.16667	.68341	.995	-2.0795	1.7462
	Eight-Week Control Group	-.80833	.68341	.644	-2.7212	1.1045
No-Excercise	Active	2.25000*	.68341	.018	.3372	4.1628
	Passive	.16667	.68341	.995	-1.7462	2.0795
	Eight-Week Control Group	-.64167	.68341	.785	-2.5545	1.2712
Eight-Week Control Group	Active	2.89167*	.68341	.002	.9788	4.8045
	Passive	.80833	.68341	.644	-1.1045	2.7212
	No-Excercise	.64167	.68341	.785	-1.2712	2.5545

***. The mean difference is significant at the 0.05 level.**

Inference

We can see from the highlighted values from above that between groups compared there is a significance value of .003 which is below .05 and thus shows that there is significance to show that there the mean average in months for infants walking is different when considering our dependent variable of activity level. We therefore **reject the null hypothesis** which assumes no difference in mean averages and accept the alternative hypothesis.

Problem 2

Aspirin is known to induce "microbleeding" in the gastrointestinal system, as evidence by minute amounts of blood in the stool. Arsenault et al. (1976) reported on a new agent, R-803, studying its effect in comparison to placebo and aspirin (900 mg, q.i.d.) on blood loss. The study design was a crossover design where each subject received all three treatments. Each subject was placed on each drug for one week, with a washout week between treatments. The order in which the drugs were administered to each patient was random. The following table shows the average amount of blood lost per day (ml) over a week. The data is as follows:

Mean Blood Loss (ml/day)

Subject	1	2	3	4	5	6	7	8	9
Placebo	0.45	0.54	0.69	0.53	3.03	0.78	0.14	0.82	0.96
R-803	0.82	0.39	0.67	1.19	1.18	1.07	0.49	0.14	0.80
Aspirin	18.00	6.46	6.19	6.52	7.18	9.39	6.93	1.57	4.03

Is there a difference in the amount of blood loss among the treatments?

Hypothesis

$H_0 – m_1 = m_2 = m_3$
H_1 – Two or more means differ across the drug types

If rejected, the drug type did have an effect on blood loss per day (ml) over a week.

$H_0 – m_1 = m_2 = m_3 = m4 = m5 = m6 = m7 = m8 = m9$
H_1 – Two or more means differ across the blocks

If rejected, then blocking was important in this test.

Assumptions

- Subjects were selected using a random sample.
- Administration of drugs to the patients were done randomly as well.
- Crossover exists in the fact that each subject was administered each of the three treatments.
- The dependent variable (blood lost per day) is continuous (interval or ratio) with three dependent groups

With the stated assumptions, the best statistical test would be to run a randomized block ANOVA test.

Results

Between-Subjects Factors

		Value Label	N
Drug Type	0	Placebo	9
	1	R-803	9
	2	Asprin	9
Block	1		3
	2		3
	3		3
	4		3
	5		3
	6		3
	7		3
	8		3
	9		3

Tests of Between-Subjects Effects

Dependent Variable:Blood Loss (ml)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	558.607[a]	11	50.782	7.179	.000
DrugType	257.275	2	128.638	18.184	.000
Block	58.571	8	7.321	1.035	.451
Error	113.187	16	7.074		
Total	671.794	27			

a. R Squared = .832 (Adjusted R Squared = .716)

Inference

Seeing from the above tests between subjects, we can see that the significance factor for Drug Type is .000 and for Block it is .451. We therefor reject both null hypothesis and assume that that the mean differs were significant between drug types and accept the alternative hypothesis which accepts that blocking did play a significant factor in this experiment.

Problem 3

To investigate the effect of different drugs to relieve itching, 3 drugs were compared to both placebo and no drug. The study design was a crossover design where each participant underwent one treatment per day. Thus, individuals served as "blocks". The subjects were given the therapy intravenously, and then itching was induced on their forearms with an effective itch stimulus. The subjects recorded the durations of the itching in seconds. The following data were obtained:

Patient	NO DRUG	PLACEBO	PAPA - VERINE	MORPHINE	PENTO-BARBITAL
1	174	263	105	199	108
2	224	213	103	143	341
3	260	231	145	113	159
4	255	291	103	225	135
5	165	168	144	176	239
6	237	121	94	144	136
7	191	137	35	87	140
8	100	102	133	120	134
9	115	89	83	100	185
10	189	433	237	173	198

Is there evidence to suggest that certain therapies are better than others?

Hypothesis

$H_0 – m_1 = m_2 = m3 = m 4 m 5$

H_1 – Two or more means differ across the drug types

If rejected, the drug type did have an effect on blood loss per day (ml) over a week.

Assumptions

- Groups being considered are independent and categorical consisting of more than two.
- The dependent variable (activity level) is continuous (interval or ratio) and affects the time at which an infant will walk.
- The sample of new boards in comes from a simple random sample
- Random sample of considered activity levels is normally distributed for each category of the independent variables.
- Equality of variances between the independent groups.
- Independence of cases.

With the stated assumptions, the best statistical test would be to run a randomized block ANOVA test.

Results

Between-Subjects Factors

		Value Label	N
Drug Type	0	No Drug	10
	1	Placebo	10
	2	Morphine	10
	3	Papaverine	10
	4	Pentobarbital	10
Block	1		5
	2		5
	3		5
	4		5
	5		5
	6		5
	7		5
	8		5
	9		5
	10		5

Tests of Between-Subjects Effects

Dependent Variable:Recorded Time

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	134717.300[a]	13	10362.869	2.924	.005
Intercept	1409520.500	1	1409520.500	397.648	.000
DrugType	48534.800	4	12133.700	3.423	.018
Block	86182.500	9	9575.833	2.701	.016
Error	127607.200	36	3544.644		
Total	1671845.000	50			
Corrected Total	262324.500	49			

a. R Squared = .514 (Adjusted R Squared = .338)

Recorded Time

Tukey B[a,b]

Drug Type	N	Subset

		1	2
Morphine	10	118.20	
Papaverine	10	148.00	148.00
Pentobarbital	10	177.50	177.50
No Drug	10	191.00	191.00
Placebo	10		204.80

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 3544.644.

a. Uses Harmonic Mean Sample Size = 10.000.

b. Alpha = 0.05.

Inference

From the above results we see that the significance factor on the Drug Type is .018 which is less than .05. We therefore **reject the null hypothesis** and conclude that the mean averages different across the different drug types and can assume that certain drug types are better than others.

Also from considering the second hypothesis, the significance factor is .16 in the blocking test. We **reject the null hypothesis** and can assume that blocking was significant in that it is below .05 and accept that blocking did mater in our example.

Problem 4

To investigate the effects of three different anesthesia therapies on concentrations of plasma epinephrine, 30 dogs were randomly selected to participate in a controlled study. The 30 dogs were randomly assigned to one of the following treatment conditions: Isofluorane; Halothane; or Cyclopropoane. For each dog, the concentrations of plasma epinephrine were measured in nanograms per milliliter. The following data were obtained:

Anestheia										
Isofluorane	.28	.51	1.00	.39	.29	.36	.32	.69	.17	.33
Halothane	.30	.39	.63	.68	.38	.21	.88	.39	.51	.32
Cyclopropoane	1.07	1.35	.69	.28	1.24	1.53	.49	.56	1.02	.30

Is there a difference in the treatment effects?

Hypothesis

H_0 – $M_1 = M_2 = M_3$ or that the mean is the same across the three types of Anestheia.

H_1 – The means are not the same across the three types of Anestheia and therefore one is better than the other two.

Assumptions

- Groups being considered are independent and categorical consisting of more than two.
- The dependent variable (effects from Anestheia treatment) is continuous (interval or ratio) and affects concentrations of Plasma epinephrine.
- The sample of dogs come from a simple random sample
- Random sample of considered Anestheia treatment is normally distributed for each category of the independent Anvariables.
- Equality of variances between the independent groups.
- Independence of cases.

Results

Descriptives

Plasma Level

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Isofluorane	10	8.2550	17.33856	5.48293	-4.1483	20.6583	.17	51.00
Halothane	10	.4690	.20529	.06492	.3221	.6159	.21	.88
Clyclopropane	10	.8530	.44826	.14175	.5323	1.1737	.28	1.53
Total	30	3.1923	10.32743	1.88552	-.6640	7.0487	.17	51.00

ANOVA

Measurement

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.081	2	.540	5.355	.011
Within Groups	2.725	27	.101		
Total	3.806	29			

Robust Tests of Equality of Means

Measurement

	Statistic[a]	df1	df2	Sig.
Welch	3.443	2	16.898	.056
Brown-Forsythe	5.355	2	18.046	.015

a. Asymptotically F distributed.

Inference

In review of the results we compare the means see that they greatly vary. As well, we can examine the significance factor and see that it is 1.1% and less that 5%. We therefore **reject the null hypothesis** and accept that there is a difference between the three group of treatments.

Problem 5

To investigate the effect of time on a new medical therapy for the treatment of pain, 7 patients were followed over a 3-hour period. Patients were asked to indicate the amount of pain they were experiencing on a scale from 1-20 (20 being worst pain). Baseline data was collected just before the administration of the therapy.

Patient	Baseline	Hour 1	Hour 2	Hour 3
1	17	16	15	8
2	14	13	13	6
3	11	11	10	5
4	10	9	8	4
5	9	9	7	3
6	7	7	5	2
7	5	6	4	2

17HINT: This is a within-subjects design that requires blocking on the patient.

What does the data above suggests about the effectiveness of the new therapy? What effect does time have?

Hypothesis

H_0 – The mean pain levels across time are the same across patients treated.
H_1 – The mean pain levels across time are not the same across patients treated.

Assumptions

- Pain scale variable is interval or ratio (continuous)
- The time interval variable is approximately normally distributed
- Homogeneity of covariance (sphericity)
- There was at least one independent variable where participants are tested on the same dependent variable (pain level) at least 2 times.

Results

Within-Subjects Factors

Measure:Pain

Time	Dependent Variable
1	Baseline
2	Hour1
3	Hour2
4	Hour3

Descriptive Statistics

	Mean	Std. Deviation	N
Baseline	10.43	4.077	7
Hour1	10.14	3.485	7
Hour2	8.86	4.059	7
Hour3	4.29	2.215	7

We can see from the above table that the mean pain level decreases in trend over time being the lowest score over the third hour observed.

Tests of Within-Subjects Effects

Measure:Pain

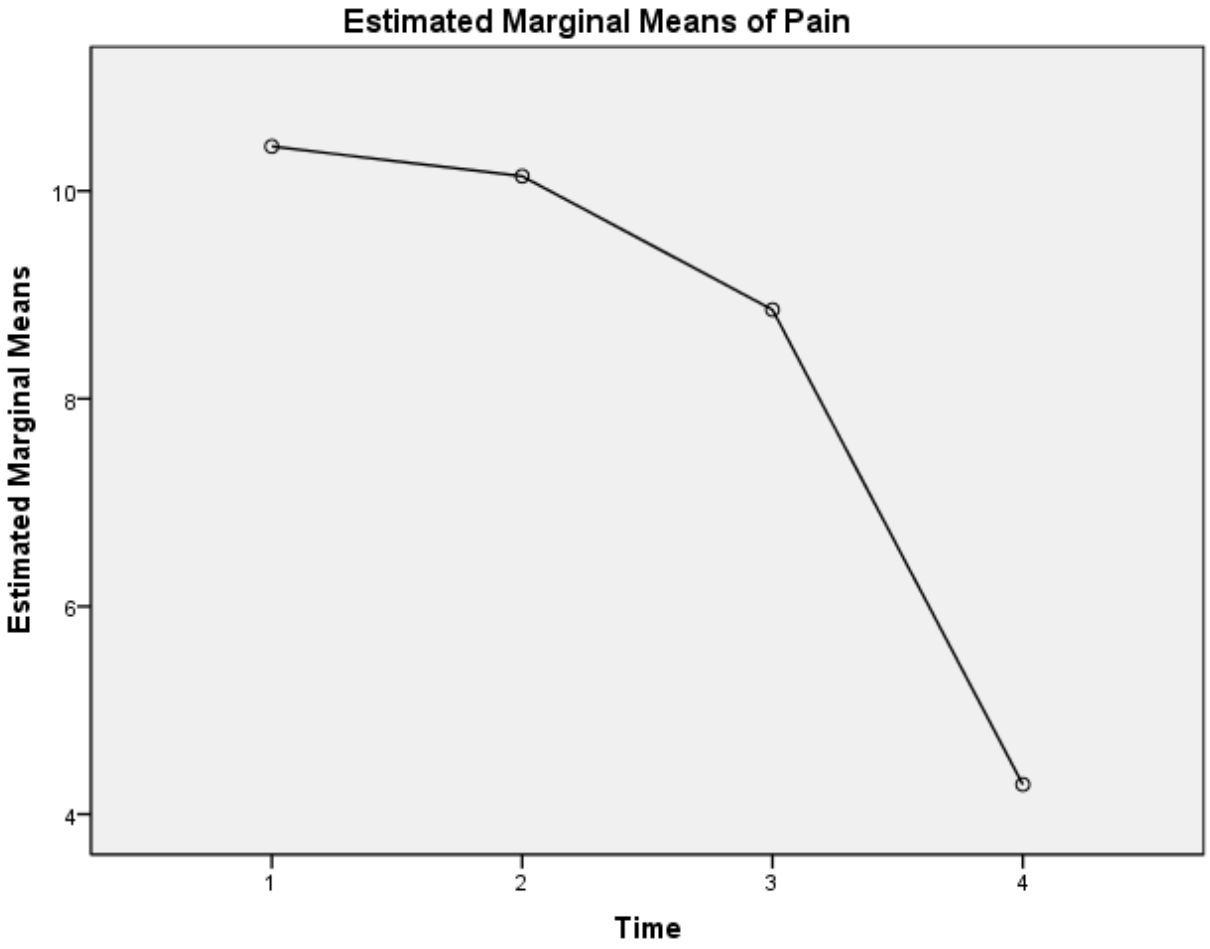
Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	170.000	3	56.667	63.750	.000	.914
	Greenhouse-Geisser	170.000	1.198	141.920	63.750	.000	.914
	Huynh-Feldt	170.000	1.330	127.856	63.750	.000	.914
	Lower-bound	170.000	1.000	170.000	63.750	.000	.914
Error(Time)	Sphericity Assumed	16.000	18	.889			
	Greenhouse-Geisser	16.000	7.187	2.226			
	Huynh-Feldt	16.000	7.978	2.006			
	Lower-bound	16.000	6.000	2.667			

Tests of Between-Subjects Effects

Measure:Pain

Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1989.143	1	1989.143	41.898	.001	.875
Error	284.857	6	47.476			



Inference

From the above results we can see graphically that the mean pain level across time decreases steeply from the baseline established and continuing through hours 1, 2 and 3. The significance factor is 0%

and less than 5% so we **reject the null hypothesis** and accept that the means are not the same across time for pain levels for patients observed.