

Worksheet – 2-Way Mixed Effects ANOVA – Women PBA Bowlers on 4 Oil Patterns

Dataset: wpba2009.dat Source: www.pba.com

Description: Scores for 15 women professional bowlers of 4 oil patterns, each for 2 sets of 7 games per set. All at Allen Park, MI.

Bowlers: 1=Diandra Abaty, 2=Shalin Zulkiffi, 3=Liz Johnson, 4=Kelly Kulick, 5=Clara Guerrero, 6=Jennifer Petrick, 7=Wendy MacPherson, 8=Shannon Pluhowski, 9=Stephanie Nation, 10=Tammy Boomershine, 11=Amanda Fagan, 12=Aumi Guerra, 13=Michelle Feldman, 14=Shannon O'Keefe, 15=Jodie Woessner

Oil Patterns: 1=Viper, 2=Chameleon, 3=Scorpion, 4=Shark

Variables/Columns:

Bowler 7-8 Oil Pattern 16 Set Number 24 Game of Set 32 Score 38-40 /* max = 300 */

Fixed Factor (A) Pattern a= 4 Random Factor (B) Bowler b= 15

Model:

Source	df	SS	MS	F*	F(.95)	P-value
Oil	4-1=3	8785	2928.3	$\frac{2928.3}{819.6} = 3.573$	3.42=72.827	<.05
Bowler	15-1=14	29965	2140.4	$\frac{2140.4}{819.6} = 2.612$	14.42=71.935	<.05
Oil*Bowler	3(14)=42	34423	819.6	1.262	42.750=71.400	>.05
Error	4(15)(14)=780	506679	649.6	—	—	—
Total	4(15)(14)+1=839	579852	—	—	—	—

Test for Oil*Bowler Interaction: Test Statistic 1.262 Rejection Region TS > 1.400

Test for Oil Pattern Effects: Test Statistic 3.573 Rejection Region TS > 2.827

Test for Bowler Effects: Test Statistic 2.612 Rejection Region TS > 1.935

Obtain a 95% CI for σ_B^2 Estimate $\frac{MSB-MSAB}{aB} = 23.59$ df ≈ 5 CI: $\left(\frac{5(23.59)}{12.83}, \frac{5(23.59)}{0.83} \right) = (9.19, 142.1)$

$$df \approx \frac{(23.59)^2}{\frac{(2140.4)^2}{56} + \frac{(819.6)^2}{42}} = \frac{556.29}{104.35 + 5.10} = 5.09 \approx 5$$

Tukey's HSD and Bonferroni's MSD for Comparing Oil Pattern Means:

$$q(.05, 4, 42) \approx 3.784$$

$$t(1 - .025/6, 42) \approx 2.772$$

$$HSD = 3.784 \sqrt{\frac{819.6}{15(14)}} = 7.48$$

$$MSD = 2.772 \sqrt{\frac{2(819.6)}{15(14)}} = 7.74$$