QSCI 482 Winter HW7

1a. One-way fixed effects ANOVA

Ho: $X_{ij} = \mu + \varepsilon_{ij}$
Ha: $X_{ij} = \mu + \tau_i + \varepsilon_{ij}$, where $\varepsilon_{ij} \sim N(0, \sigma_2)$

Ho: $\mu_0 = \mu_{25} = \mu_{75} = \mu_{200} = \mu$
Ha: $\mu_i \neq \mu$ for at least one i

Ho: $\tau = 0$
Ha: $\tau \neq 0$

Passes	Veg height	Passes	Group mean	Group s	Group s2	Grand mean	Tau-i-hat	n*groupmean^2	sum group squared
0	20.7	0	18	1.991649233	3.96666667	12.74375	5.25625	1296	1307.9
0	15.9								
0	17.8								
0	17.6								
25	12.9	25	12	2.02155056	4.08666667	12.74375	-0.74375	576	588.26
25	13.4								
25	12.7								
25	9								
75	11.8	75	11.975	0.505799697	0.25583333	12.74375	-0.76875	573.6025	574.37
75	12.6								
75	11.4								
75	12.1								
200	7.6	200	9	1.003327796	1.00666667	12.74375	-3.74375	324	327.02
200	9.5								
200	9.9								
200	9								
		All combined	12.74375	3.643252896					2797.55

SSTr   171.151875

SSE   27.9475 sum(all group observations squared) - sum(n times the group mean sqaured)

Also calculate as wighted variances numerator
(3*3.967 + 3*4.087 + 3*0.256 + 3*1.007)/12

1c.
SOV	Df	SS	MS	F	P
passes	3	171.15	57.05	24.5	2.10E-05
Residuals	12	27.95	2.33		

2a. This is a random effects model because they are trying to make inferences about all tires, not just the levels in the experiment.

2b. One-way random effects ANOVA

Ho: $X_{ij} = \mu + \varepsilon_{ij}$
Ha: $X_{ij} = \mu + \theta_i + \varepsilon_{ij}$, where $\varepsilon_{ij} \sim N(0, \sigma_2)$

Ho: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu$
Ha: $\mu_i \neq \mu$ for at least one i

Ho: $\theta = 0$
Ha: $\theta \neq 0$

2c.
SOV	Df	SS	MS	F	P
type	3	913.8	304.6	75.68	1.14E-09
Residuals	16	64.4	4.03		

Reject Ho. There is strong evidence to support the hypothesis that in general, tire type will affect tread durability

3a.
treatment	group means	grand mean	tau-i-hat
T1	3.29	7.49	-4.2
T2	10.26	7.49	2.77
T3	8.16	7.49	0.67

T4		8.18	7.49	0.69			
T5		7.56	7.49	0.07			
mean		7.49			SSTr		104.9712

SOV	DF	SS	MS	F	P
Treatment	4	104.9712	26.2428	6.54107677	0.00297
Error	15		4.012		
	19				

3b.

	T2	T3	T4	T5		qcrit = q0.1, 15, 5 = 3.828
T1	6.9596	4.8627	4.8827	4.2636		
T2		2.0969	2.0769	2.6960		
T3			0.0200	0.5991		
T4				0.6191		

			sqrt(MSE/(n))	qobs		Signficiant difference?
T1-T2	-6.97	6.97	4.012	1.001498877	6.95956847	*
T1-T3	-4.87	4.87	4.012	1.001498877	4.8627114	*
T1-T4	-4.89	4.89	4.012	1.001498877	4.88268146	*
T1-T5	-4.27	4.27	4.012	1.001498877	4.26360938	*
T2-T3	2.1	2.1	4.012	1.001498877	2.09685707	
T2-T4	2.08	2.08	4.012	1.001498877	2.076887	
T2-T5	2.7	2.7	4.012	1.001498877	2.69595909	
T3-T4	-0.02	0.02	4.012	1.001498877	0.01997007	
T3-T5	0.6	0.6	4.012	1.001498877	0.59910202	
T4-T5	0.62	0.62	4.012	1.001498877	0.61907209	

1   2   3   4   5

4a   Power would decrease as more treatment groups are used

4b   Power would increase if more replicates are used

4c   >0.99   sqrt(4*(9^2)/(2*4*2.33))   4.169

4d   >0.99 (and larger than in 4c)