

- Q1. A psychology research group investigated four different therapies for the treatment of major depressive disorder using a randomized experimental study. Subjects in the study underwent an initial assessment, and then a second assessment after the course of treatment was completed. The reduction of depression symptoms, measured on a standardized scale, was then recorded.

Summary statistics from the study were recorded as follows (using the standard notation): the sample size is $n = 21$, $SST = 15.482$ and $SSE = 3.018$.

From the given information:

- (a) Compute the ANOVA F-statistic. 5 MARKS
- (b) Report the conclusion of an ANOVA F-test at the $\alpha = 0.05$ level. 5 MARKS
- (c) The therapy group sizes are 5, 5, 5 and 6. Does the lack of balanced replication imply that different conclusion from that in (b) should be made ? Justify your answer. 2 MARKS
- (d) Compute the sample variance for the outcome data. 4 MARKS
- (e) In post-hoc testing, all the therapy groups are to be compared in a series of two sample t-tests. At what significance level should each individual test be carried out in order to maintain a Familywise Type 1 Error rate of $\alpha_F = 0.01$? 4 MARKS

Q2. Two factors were investigated to assess their impact on the yield of a chemical experiment:

- Catalyst: three different catalysts were used;
- Experiment temperature: the experiment was run at four different temperatures.

A balanced replicated experimental design with $r = 3$ replicates was used. The following ANOVA table was produced: the p-value column is not included, and some values have been replaced by labels (i) to (vi).

SOURCE	DF	SS	MS	F
Catalyst	(i)	1.341	0.670	(vi)
Temperature	(ii)	(iv)	1.316	0.756
Interaction	(iii)	3.209	0.535	0.307
ERROR	24	41.778	(v)	
TOTAL	35	50.275		

- (a) Fill in the omitted values marked (i) to (vi) 6 MARKS
- (b) Report the conclusions of the three ANOVA F-tests at significance level of $\alpha = 0.05$. Justify your answers. 6 MARKS
- (c) Explain, with justification, how the conclusions in (b) would change if the Temperature factor was in fact a Blocking factor. 3 MARKS
- (d) If the interaction was omitted from the fitted model, so any effect of each of the factors was assumed to act additively, explain how entries (i), (iv) and (vi) would change. Justify your answer. 3 MARKS
- (e) Given only the information provided and a suitable critical value from an F-distribution table, would it be possible to carry out a test of the null hypothesis that there is no Catalyst effect based on a single factor model (that is, assuming a one factor Completely Randomized Design) ? Justify your answer 2 MARKS