Carleton University
School of Mathematics and Statistics
STAT 2509 A - Assignment #3

DUE: June 12th, 2025 (to be submitted on BrightSpace before 10:00am)

1. Refers to Q.1 on Assignment 2.

In order to increase sales, a car dealership has developed a 30-second TV ad to advertise a discount event. The data on the number of ads per day and number of cars sold are provided in the following table:

No. of ads per day x_i	**No. of cars sold** y_{ij}	n_i	$\bar{y}_i$	$\sum_j (y_{ij} - \bar{y}_i)^2$
1	21, 18, 17	3	18.66667	8.666667
2	24, 22, 26	3	24	8
3	34, 29, 32	3	31.66667	12.66667
4	45, 41, 35	3	40.33333	50.66667

(a) Fit the model $y = \beta_0 + \beta_1 x + \varepsilon$ and test for lack-of-fit (by hand), using α = 0.05.

$\sum x_i$ = 30 , $\sum y_i$ = 344 , $\sum x_i^2$ = 90 , $\sum y_i^2$ = 10 742 , $\sum x_i y_i$ = 969

(b) Verify your results using **SPSS**.

2. A professor wants to determine the final grades (y) for a class of 20 statistics students based on their midterm grades (x_1) and homework grades (x_2). The grades are given in the following table:

Final Grade (y)	**Midterm Grade(** x_1 **)**	**Homework Grade(** x_2 **)**	**Final Grade** (y)	**Midterm Grade(** x_1 **)**	**Homework Grade(** x_2 **)**
75	68	60	70	71	86
63	49	94	96	95	94
57	60	91	76	61	94
88	68	81	75	72	94
88	97	80	85	87	79
79	82	92	40	40	30
82	59	74	74	66	92
73	50	89	70	58	82
90	73	96	75	58	94
62	39	87	72	77	78

Consider the model $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$.

(a) State all assumptions which are necessary for the statistical inference.

(b) Use **SPSS** to obtain estimates of the population parameters β_0, β_1, β_2 and hence find the fitted least squares prediction line.

(c) Use **SPSS** to obtain the ANOVA table. Use this ANOVA table to test the usefulness of the full model. Use α = 0.01.

(d) Use the *t*-test to test whether each of the independent variables is significant in predicting 'the final grade'. Use α = 0.01. (Hint: use **SPSS** output from part (a)).

(e) Calculate (by hand) the values of the coefficient of determination, r^2, and the *adjusted* r^2 and interpret their meanings in this problem. What is your conclusion about the usefulness of the model? Verify your results using **SPSS**.

(f) Use **SPSS** to obtain the ANOVA table for the reduced model. Test whether 'the homework grade' is significant in predicting 'the final grade'. Use α = 0.01. How does this compare to your answer in part d)?