**Introductory Statistics II** 姓名: _____

**Second Midterm Exam** 學號: _____

1. 交卷時請將試卷連同答案本一起交回（未繳回試卷者視同未繳答案本）；
2. 請使用試卷後方做為計算紙使用（嚴禁使用其他計算紙）；
3. 請依照座位表入座，並準備學生證供查驗;
4. 所有計算題必須列出計算過程，且與最後答案相符合才給分。計算題僅有最後答案不予任何分數;
5. 請寫出計算過程以便給部分分數;
6. 答卷時間：10：10 – 12：00;
7. 總分：100

**Part I. Multiple Choice (Only <u>one</u> answer is correct)**

1. (3%) In a multiple regression analysis involving 25 data points, the standard error of estimate squared is calculated as 1.8, and the sum of squares for error as *SSE*=36. Then, the number of the independent variables must be:

(A) 6

(B) 5

(C) 4

(D )3

2. (3%) In testing the validity of multiple regression model, a large value of the *F*-test statistic indicates that:

(A) most of the variation in the independent variables is explained by the variation in y

(B) most of the variation in y is explained by the regression equation

(C) most of the variation in y is unexplained by the regression equation

(D) the model provides a poor fir.

3. (3%) Suppose you fit the regression model $y=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\varepsilon$ to a dataset containing 30 observations. Suppose that the relevant assumptions are satisfied. To test $H_0:\beta_1=\beta_2=\beta_3=\beta_4=\beta_5=0$, use:

(A) the *t* test with 5 degrees of freedom

(B) the chi-square test with 5 degrees of freedom

(C) the *F* test with (24, 5) degrees of freedom

(D) the *F* test with (5, 24) degrees of freedom

4. (3%) Given the following output for the regression model, $Y_i=\beta_0+\beta_1x_{1i}+\beta_2x_{2i}+\beta_3x_{3i}+\varepsilon_i$, $i=1,2,\ldots,40$, what of the following statements are true.

| Predictor | Parameter Estimate | Standard Error | $t$ | $p$ |
|---|---|---|---|---|
| Intercept | 249.32 | 1.455 | 171.35 | 0.0001 |
| $X_1$ | 1.46 | 2.058 | 0.71 | 0.4832 |
| $X_2$ | 13.94 | 2.446 | 5.70 | 0.0001 |
| $X_3$ | 19.26 | 1.922 | 10.02 | 0.0001 |

ANOVA Table

| VS | df | SS | MS | $F$ | $p$ |
|---|---|---|---|---|---|
| Regression | 3 | 2794.39 | 931.46 | 43.98 | 0.0001 |
| Error | 36 | 762.3 | 21.18 | | |
| Total | 39 | 3556.69 | | | |

(A) $F$=43.98 can be used to test $H_0 : \beta_1 = \beta_2 = \beta_3$

(B) we reject $H_0 : \beta_1 = 0$, holding $X_2$ and $X_3$ constant

(C) we reject $H_0 : \beta_2 = 0$

(D) the $p$ value of 0.4832 is based on the $t$ distribution with 39 degrees of freedom

**Part II: Show the work to receive partial credit. (請列出計算過程)**

1. (22%) A manufacturer of television sets is interested in the effect on tube conductivity(導電率) of three different types of coating(塗料) for color picture tubes. The following conductivity data are obtained:

| Coating Type | Conductivity | | | |
|---|---|---|---|---|
| 1 | 9 | 11 | 10 | 12 |
| 2 | 6 | 9 | 7 | 10 |
| 3 | 5 | 8 | 8 | 6 |

(a) Indicate the (i) design type, (1%) (ii) response variable, (1%) (iii) factor and factor level (1%), and (iv) experimental unit for this design. (1%)

(b) Is there evidence of a significant difference in conductivity due to coating type? Test at the 0.05 significance level. (6%)

(c) (i)Use pairwise comparison method (Tukey's method) to compare treatment means. Interpret the results. (5%) (ii)Which of the coating types would you select, given the objective is minimum conductivity? (1%)

(d) Compute a 95% confidence interval for the mean of coating type 3. Interpret the results. (3%)

(e) What is the statistical assumption for analyzing this problem? (3%)

2. (12%) An engineer is conducting an experiment on eye focus time. He is interested in the effect of the distance of the object from the eye on the focus time. Three different distances are of interest. Because there maybe difference among individuals, he decides to conduct an experiment to eliminate subject-to-subject variation. He has four subjects available for the experiment. The time (in seconds) of eye focus is obtained in the following table.

| | Subject | | | |
|---|---|---|---|---|
| Distance(feet) | 1 | 2 | 3 | 4 |
| 1 | 9 | 11 | 10 | 12 |
| 2 | 6 | 9 | 7 | 10 |
| 3 | 5 | 8 | 8 | 6 |

(a) (i) Indicate the design type. (1%) (ii) What is the factor of interest? (1%) (iii) What is the experimental unit? (1%)

(b) Is there evidence of a significant difference in the average focus time for the three different distances? Test at the 0.05 significance level. (5%)

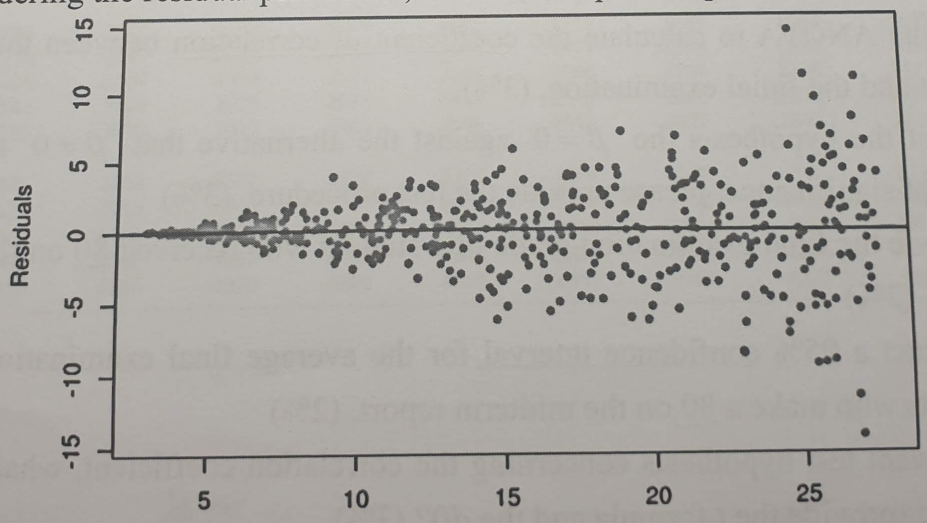
(c) Use Tukey's method to compare treatment means. Explain the results. (4%)

△3. (6%) Consider the simple linear regression model

$$y = \alpha + \beta x + \varepsilon .$$

(a) What are the three assumptions for the random error term $\varepsilon$? (3%)

(b) Considering the residual plot below, which assumption is probably not true? (3%)




4. (27%) You are given five points with these coordinates

| $x$ | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| $y$ | 1 | 1 | 3 | 5 | 5 |

(a) Find the least-squares line for the data set. (5%)

(b) Use the least-squares line to predict the value of $y$ when $x$=0.5. (3%)

(c) Construct the ANOVA table for the linear regression. (6%)

(d) Perform the $F$-test under $\alpha = 0.05$. Do the data present sufficient evidence to indicate that $y$ is linearly related to $x$? (4%)

(e) Calculate and interpret the coefficient of determination $r^2$. (4%)

(f) Obtain a 95% confidence interval for the slope of the least-squares line. Use it to test $H_0 : \beta = 2$ versus $H_a : \beta \neq 2$. (5%)

5. (21%) The grades of a class of 9 students on a midterm report (independent variable) and on the final examination (dependent variable) are shown below:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Midterm | 77 | 55 | 70 | 73 | 83 | 92 | 94 | 99 | 68 |
| Final | 82 | 67 | 78 | 56 | 69 | 87 | 98 | 97 | 65 |

Below shows the ANAVA results.

| | df | SS | MS | $F$ |
|---|---|---|---|---|
| Regression | 1 | (*a*) | 1025.32 | 10.45 |
| Error | 7 | (*b*) | 98.1 | |
| Total | 8 | 1712 | | |

| | Coefficient | Standard error | $t$ |
|---|---|---|---|
| Intercept | (*c*) | 19.67 | 0.76 |
| Midterm | (*d*) | 0.25 | |

(1) Please fill out cells (*a*) to (*d*). (8%)

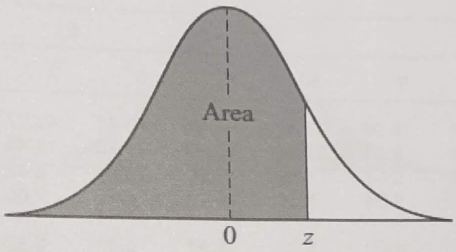
(2) Use the ANOVA to calculate the coefficient of correlation between the midterm report and the finial examination. (3%)

(3) To test the hypothesis the $\beta = 0$ against the alternative that $\beta \neq 0$ at the 0.05 level of significance, please provide the test procedure. (3%)

(4) Estimate the final examination grade of a student who received 80 on the midterm report. (2%)

(5) Construct a 95% confidence interval for the average final examination grade of students who make a 80 on the midterm report. (2%)

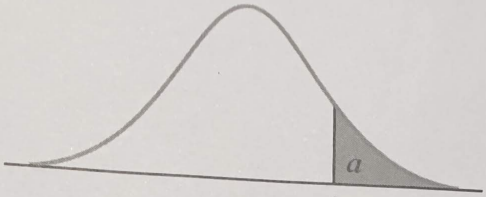
(6) If we want test hypothesis concerning the correlation coefficient, what is the test statistic (provide the $t$ formula and the $df$)? (3%)




| z | .00 | .01 | .02 | .03 | .04 | .05 | .06 | .07 | .08 | .09 |
|---|---|---|---|---|---|---|---|---|---|---|
| −3.4 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 | .0002 |
| −3.3 | .0005 | .0005 | .0005 | .0004 | .0004 | .0004 | .0004 | .0004 | .0004 | .0003 |
| −3.2 | .0007 | .0007 | .0006 | .0006 | .0006 | .0006 | .0006 | .0005 | .0005 | .0005 |
| −3.1 | .0010 | .0009 | .0009 | .0009 | .0008 | .0008 | .0008 | .0008 | .0007 | .0007 |
| −3.0 | .0013 | .0013 | .0013 | .0012 | .0012 | .0011 | .0011 | .0011 | .0010 | .0010 |
| −2.9 | .0019 | .0018 | .0017 | .0017 | .0016 | .0016 | .0015 | .0015 | .0014 | .0014 |
| −2.8 | .0026 | .0025 | .0024 | .0023 | .0023 | .0022 | .0021 | .0021 | .0020 | .0019 |
| −2.7 | .0035 | .0034 | .0033 | .0032 | .0031 | .0030 | .0029 | .0028 | .0027 | .0026 |
| −2.6 | .0047 | .0045 | .0044 | .0043 | .0041 | .0040 | .0039 | .0038 | .0037 | .0036 |
| −2.5 | .0062 | .0060 | .0059 | .0057 | .0055 | .0054 | .0052 | .0051 | .0049 | .0048 |
| −2.4 | .0082 | .0080 | .0078 | .0075 | .0073 | .0071 | .0069 | .0068 | .0066 | .0064 |
| −2.3 | .0107 | .0104 | .0102 | .0099 | .0096 | .0094 | .0091 | .0089 | .0087 | .0084 |
| −2.2 | .0139 | .0136 | .0132 | .0129 | .0125 | .0122 | .0119 | .0116 | .0113 | .0110 |
| −2.1 | .0179 | .0174 | .0170 | .0166 | .0162 | .0158 | .0154 | .0150 | .0146 | .0143 |
| −2.0 | .0228 | .0222 | .0217 | .0212 | .0207 | .0202 | .0197 | .0192 | .0188 | .0183 |
| −1.9 | .0287 | .0281 | .0274 | .0268 | .0262 | .0256 | .0250 | .0244 | .0239 | .0233 |
| −1.8 | .0359 | .0351 | .0344 | .0336 | .0329 | .0322 | .0314 | .0307 | .0301 | .0294 |
| −1.7 | .0446 | .0436 | .0427 | .0418 | .0409 | .0401 | .0392 | .0384 | .0375 | .0367 |
| −1.6 | .0548 | .0537 | .0526 | .0516 | .0505 | .0495 | .0485 | .0475 | .0465 | .0455 |
| −1.5 | .0668 | .0655 | .0643 | .0630 | .0618 | .0606 | .0594 | .0582 | .0571 | .0559 |
| −1.4 | .0808 | .0793 | .0778 | .0764 | .0749 | .0735 | .0722 | .0708 | .0694 | .0681 |
| −1.3 | .0968 | .0951 | .0934 | .0918 | .0901 | .0885 | .0869 | .0853 | .0838 | .0823 |
| −1.2 | .1151 | .1131 | .1112 | .1093 | .1075 | .1056 | .1038 | .1020 | .1003 | .0985 |
| −1.1 | .1357 | .1335 | .1314 | .1292 | .1271 | .1251 | .1230 | .1210 | .1190 | .1170 |
| −1.0 | .1587 | .1562 | .1539 | .1515 | .1492 | .1469 | .1446 | .1423 | .1401 | .1379 |
| −0.9 | .1841 | .1814 | .1788 | .1762 | .1736 | .1711 | .1685 | .1660 | .1635 | .1611 |
| −0.8 | .2119 | .2090 | .2061 | .2033 | .2005 | .1977 | .1949 | .1922 | .1894 | .1867 |
| −0.7 | .2420 | .2389 | .2358 | .2327 | .2296 | .2266 | .2236 | .2206 | .2177 | .2148 |
| −0.6 | .2743 | .2709 | .2676 | .2643 | .2611 | .2578 | .2546 | .2514 | .2483 | .2451 |
| −0.5 | .3085 | .3050 | .3015 | .2981 | .2946 | .2912 | .2877 | .2843 | .2810 | .2776 |
| −0.4 | .3446 | .3409 | .3372 | .3336 | .3300 | .3264 | .3228 | .3192 | .3156 | .3121 |
| −0.3 | .3821 | .3783 | .3745 | .3707 | .3669 | .3632 | .3594 | .3557 | .3520 | .3483 |
| −0.2 | .4207 | .4168 | .4129 | .4090 | .4052 | .4013 | .3974 | .3936 | .3897 | .3859 |
| −0.1 | .4602 | .4562 | .4522 | .4483 | .4443 | .4404 | .4364 | .4325 | .4286 | .4247 |
| −0.0 | .5000 | .4960 | .4920 | .4880 | .4840 | .4801 | .4761 | .4721 | .4681 | .4641 |

**TABLE 11(a)**
**Percentage Points of the Studentized Range, $q_{.05}(k, df)$; Upper 5% Points**

| | $k$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *df* | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1 | 17.97 | 26.98 | 32.82 | 37.08 | 40.41 | 43.12 | 45.40 | 47.36 | 49.07 | 50.59 |
| 2 | 6.08 | 8.33 | 9.80 | 10.88 | 11.74 | 12.44 | 13.03 | 13.54 | 13.99 | 14.39 |
| 3 | 4.50 | 5.91 | 6.82 | 7.50 | 8.04 | 8.48 | 8.85 | 9.18 | 9.46 | 9.72 |
| 4 | 3.93 | 5.04 | 5.76 | 6.29 | 6.71 | 7.05 | 7.35 | 7.60 | 7.83 | 8.03 |
| 5 | 3.64 | 4.60 | 5.22 | 5.67 | 6.03 | 6.33 | 6.58 | 6.80 | 6.99 | 7.17 |
| 6 | 3.46 | 4.34 | 4.90 | 5.30 | 5.63 | 5.90 | 6.12 | 6.32 | 6.49 | 6.65 |
| 7 | 3.34 | 4.16 | 4.68 | 5.06 | 5.36 | 5.61 | 5.82 | 6.00 | 6.16 | 6.30 |
| 8 | 3.26 | 4.04 | 4.53 | 4.89 | 5.17 | 5.40 | 5.60 | 5.77 | 5.92 | 6.05 |
| 9 | 3.20 | 3.95 | 4.41 | 4.76 | 5.02 | 5.24 | 5.43 | 5.59 | 5.74 | 5.87 |
| 10 | 3.15 | 3.88 | 4.33 | 4.65 | 4.91 | 5.12 | 5.30 | 5.46 | 5.60 | 5.72 |
| 11 | 3.11 | 3.82 | 4.26 | 4.57 | 4.82 | 5.03 | 5.20 | 5.35 | 5.49 | 5.61 |
| 12 | 3.08 | 3.77 | 4.20 | 4.51 | 4.75 | 4.95 | 5.12 | 5.27 | 5.39 | 5.51 |
| 13 | 3.06 | 3.73 | 4.15 | 4.45 | 4.69 | 4.88 | 5.05 | 5.19 | 5.32 | 5.43 |
| 14 | 3.03 | 3.70 | 4.11 | 4.41 | 4.64 | 4.83 | 4.99 | 5.13 | 5.25 | 5.36 |
| 15 | 3.01 | 3.67 | 4.08 | 4.37 | 4.60 | 4.78 | 4.94 | 5.08 | 5.20 | 5.31 |
| 16 | 3.00 | 3.65 | 4.05 | 4.33 | 4.56 | 4.74 | 4.90 | 5.03 | 5.15 | 5.26 |
| 17 | 2.98 | 3.63 | 4.02 | 4.30 | 4.52 | 4.70 | 4.86 | 4.99 | 5.11 | 5.21 |
| 18 | 2.97 | 3.61 | 4.00 | 4.28 | 4.49 | 4.67 | 4.82 | 4.96 | 5.07 | 5.17 |
| 19 | 2.96 | 3.59 | 3.98 | 4.25 | 4.47 | 4.65 | 4.79 | 4.92 | 5.04 | 5.14 |
| 20 | 2.95 | 3.58 | 3.96 | 4.23 | 4.45 | 4.62 | 4.77 | 4.90 | 5.01 | 5.11 |
| 24 | 2.92 | 3.53 | 3.90 | 4.17 | 4.37 | 4.54 | 4.68 | 4.81 | 4.92 | 5.01 |
| 30 | 2.89 | 3.49 | 3.85 | 4.10 | 4.30 | 4.46 | 4.60 | 4.72 | 4.82 | 4.92 |
| 40 | 2.86 | 3.44 | 3.79 | 4.04 | 4.23 | 4.39 | 4.52 | 4.63 | 4.73 | 4.82 |
| 60 | 2.83 | 3.40 | 3.74 | 3.98 | 4.16 | 4.31 | 4.44 | 4.55 | 4.65 | 4.73 |
| 120 | 2.80 | 3.36 | 3.68 | 3.92 | 4.10 | 4.24 | 4.36 | 4.47 | 4.56 | 4.64 |
| $\infty$ | 2.77 | 3.31 | 3.63 | 3.86 | 4.03 | 4.17 | 4.29 | 4.39 | 4.47 | 4.55 |




| df | $t_{.100}$ | $t_{.050}$ | $t_{.025}$ | $t_{.010}$ | $t_{.005}$ | df |
|---|---|---|---|---|---|---|
| 1 | 3.078 | 6.314 | 12.706 | 31.821 | 63.657 | 1 |
| 2 | 1.886 | 2.920 | 4.303 | 6.965 | 9.925 | 2 |
| 3 | 1.638 | 2.353 | 3.182 | 4.541 | 5.841 | 3 |
| 4 | 1.533 | 2.132 | 2.776 | 3.747 | 4.604 | 4 |
| 5 | 1.476 | 2.015 | 2.571 | 3.365 | 4.032 | 5 |
| 6 | 1.440 | 1.943 | 2.447 | 3.143 | 3.707 | 6 |
| 7 | 1.415 | 1.895 | 2.365 | 2.998 | 3.499 | 7 |
| 8 | 1.397 | 1.860 | 2.306 | 2.896 | 3.355 | 8 |
| 9 | 1.383 | 1.833 | 2.262 | 2.821 | 3.250 | 9 |
| 10 | 1.372 | 1.812 | 2.228 | 2.764 | 3.169 | 10 |
| 11 | 1.363 | 1.796 | 2.201 | 2.718 | 3.106 | 11 |
| 12 | 1.356 | 1.782 | 2.179 | 2.681 | 3.055 | 12 |
| 13 | 1.350 | 1.771 | 2.160 | 2.650 | 3.012 | 13 |
| 14 | 1.345 | 1.761 | 2.145 | 2.624 | 2.977 | 14 |
| 15 | 1.341 | 1.753 | 2.131 | 2.602 | 2.947 | 15 |
| 16 | 1.337 | 1.746 | 2.120 | 2.583 | 2.921 | 16 |
| 17 | 1.333 | 1.740 | 2.110 | 2.567 | 2.898 | 17 |
| 18 | 1.330 | 1.734 | 2.101 | 2.552 | 2.878 | 18 |
| 19 | 1.328 | 1.729 | 2.093 | 2.539 | 2.861 | 19 |
| 20 | 1.325 | 1.725 | 2.086 | 2.528 | 2.845 | 20 |

***Critical value for F test:***

$F_{1,2,0.05} = 18.513$, $F_{1,3,0.05} = 10.128$, $F_{1,4,0.05} = 7.709$, $F_{1,5,0.05} = 6.608$;

$F_{1,2,0.025} = 38.506$, $F_{1,3,0.025} = 17.443$, $F_{1,4,0.025} = 12.218$, $F_{1,5,0.025} = 10.007$