UNIVERSITI SAINS MALAYSIA
Second Semester Examination
Academic Session 1997/98

February 1998

AGW615 ADVANCED BUSINESS STATISTICS

Time: [3 hours]

INSTRUCTION:
Please ensure that this examination paper consists of 11 printed pages before you begin.
Answer all questions in SECTION A and any ONE question from SECTION B

1. During the economic crisis, a bank manager collected the following data of all 350 defaulting loans.

Nature of Business	Collateral Value	
	Sufficient	Insufficient
Exporters	33	109
Importers	63	145

If an auditor is to select a defaulting loan at random from this set of loans, what is the probability that the loan

a. had sufficient collateral?
b. was taken by an importer?
c. had insufficient collateral if it was taken by an importer?
d. was taken by an exporter if the loan collateral value is sufficient?

(10 marks)

2. Royal Malaysian Air Force (RMAF) regularly purchases a particular spare part used in its aircraft's navigation systems that need replacement regularly. RMAF made purchases in lots of 1000 pieces each time. When a shipment of parts arrives, RMAF will carry out acceptance sampling, whereby it takes a random sample from the lot, and accepts the lot if not more than a certain number (acceptance number) of defectives were found in the selected sample; otherwise the lot will be rejected and returned to the supplier.

If past records show that the supplies contains 1% defectives, what is the probability of accepting a lot that was just received, if

b. the sample was 20 pieces and the acceptance number was 1?
b. the sample was 50 pieces and the acceptance number was 2?

...2/-

If the supplier supplies at a quality level of 2% defectives, what is the producer's risk (risk of rejecting the lot and returning it to the supplier) using sampling plan (a) above?

(10 marks)

3. As the managing director of a company (with 10,000 employees) that claims to be charitable to the less fortunate, you were told that 80% of your staff, recently contributed to the North Korean Famine Fund (NKFF). You then randomly select 36 workers and found only 5 had contributed to NKFF.

a. What would you conclude? Explain using probabilities.
b. What if you had found 25 contributors?
c. How many workers do you have to ask if you are to estimate to within 2% of the true proportion of your staff who had contributed to NKFF with 98% confidence?

(15 marks)

4. Malaysian Dental Surgeon Association (MDSA) carried out tests to determine whether there are differences in three major brands of toothpaste sold in Malaysia. To achieve this objective, 15 primary school children were monitored throughout their primary school years and the number of cavities each had during this period were noted as follows.

Observation	Type of Toothpaste Used		
	1	2	3
1	19	20	18
2	15	25	12
3	22	22	16
4	17	19	17
5	19	23	15
Total	92	109	78

a. MDSA has assigned the 15 schoolchildren randomly to the three major brands of toothpaste. What conclusions can you draw at 5% significance level? Explain and state all assumptions you use in arriving at your conclusions.

b. Suppose MDSA believes that dental health depends on dietary habits and that the habits of the major races -- Malay, Chinese, Indians, Orang Asli and Others differ. What design would you suggest MDSA use, for it to come out with more valid conclusions? How would you then analyse the above data, if each of the rows in the above table represents one race? Use significance level of 5%. State the hypotheses that you are testing.

(30 marks)

...3/-

SECTION B

Answer any ONE (1) of the following questions.

5. A marketing executive for computers wishes to test market a range of new computers to determine the right combination of price and accessories that will induce purchase of the computer. Intent to purchase is measured on a scale 0 (very unlikely to purchase) to 100 (most likely to purchase). Three levels of prices (P1, P2 and P3) and three accessories packages were tested,. Each price-accessories package were judged by three potential customers who then state their likelihood of purchase. The description of the subpopulations are as follows:

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                    - - Description of Subpopulations - -

Summaries of      LSALES     Likelihood of Sales (0-100)
By levels of      AP         Accessories Package
                  PRICE      Price
```

Variable	Value	Label	Mean	Std Dev	Cases
For Entire Population			46.2222	24.9990	27
AP	1.00	Accessories Package	36.6667	7.2284	9
PRICE	1.00	Price Level 1	28.0000	3.6056	3
PRICE	2.00	Price Level 2	39.3333	3.5119	3
PRICE	3.00	Price Level 3	42.6667	2.5166	3
AP	2.00	Accessories Package	58.5556	25.6959	9
PRICE	1.00	Price Level 1	69.0000	2.6458	3
PRICE	2.00	Price Level 2	25.3333	3.2146	3
PRICE	3.00	Price Level 3	81.3333	5.1316	3
AP	3.00	Accessories Package	43.4444	32.1874	9
PRICE	1.00	Price Level 1	84.3333	3.0551	3
PRICE	2.00	Price Level 2	12.3333	2.5166	3
PRICE	3.00	Price Level 3	33.6667	5.0332	3

Total Cases = 27

a. Based upon the description above, which combination of price level and accessories package should be selected for the computer for marketing purposes?

b. A 2-way ANOVA was carried out with the following results. Interpret the solution, bearing in mind that the ultimate objective of the exercise is to determine the best combination of price and accessories package that will induce purchase.

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                *** A N A L Y S I S   O F   V A R I A N C E ***
LSALES    Likelihood of Sales (0-100)          by   AP       Accessories
                                    Package
             PRICE    Price

             UNIQUE sums of squares
             All effects entered simultaneously
```

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	8244.444	4	2061.111	159.456	.000
AP	2260.222	2	1130.111	87.430	.000
PRICE	5984.222	2	2992.111	231.481	.000
2-Way Interactions	7771.556	4	1942.889	150.309	.000
AP PRICE	7771.556	4	1942.889	150.309	.000
Explained	16016.000	8	2002.000	154.883	.000
Residual	232.667	18	12.926		
Total	16248.667	26	624.949		

c. Suppose that the above analysis was carried out using regression analysis with dummy variables whereby DAP1=1 for accessories package 1 and 0 otherwise; DAP2 = 1 for accessories package 2 and 0 otherwise; dprice1 = 1 for price level 1 and 0 otherwise; dprice2 = 1 for price level 2 and 0 otherwise; and interactions DAP11 between DAP1 and dprice1; DAP12 between DAP1 and dprice2; DAP21 between DAP2 and dprice2; and DAP22 between DAP2 and dprice2. Interpret the solution and discuss the similarities and differences with the 2-Way ANOVA results above.

(35 marks)

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           * * * *   M U L T I P L E   R E G R E S S I O N   * * * *
Listwise Deletion of Missing Data

Equation Number 1    Dependent Variable..   LSALES   Likelihood of
Sales (0-100)

Block Number  1.  Method:  Enter
   DAP1     DAP11    DAP12    DAP2     DAP21    DAP22    DPRICE1
DPRICE2

Variable(s) Entered on Step Number
   1..    DPRICE2
   2..    DAP2
   3..    DAP11
   4..    DAP21
   5..    DAP12
   6..    DPRICE1
   7..    DAP22
   8..    DAP1
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...5/-

Multiple R	.99281
R Square	.98568
Adjusted R Square	.97932
Standard Error	3.59526

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	8	16016.00000	2002.00000
Residual	18	232.66667	12.92593

F = 154.88252 Signif F = .0000

--------------- Variables in the Equation --------------------------

Variable	B	SE B	Beta	Tolerance	VIF	T	Sig T
DAP1	9.000000	2.935521	172946	.250000	4.000	3.066	.0067
DAP11	-65.333333	4.151454	-.836971	.281250	3.556	-15.737	.0000
DAP12	18.000000	4.151454	.230594	.281250	3.556	4.336	.0004
DAP2	47.666667	2.935521	.915971	.250000	4.000	16.238	.0000
DAP21	-63.000000	4.151454	-.807079	.281250	3.556	-15.175	.0000
DAP22	-34.666667	4.151454	-.444107	.281250	3.556	-8.350	.0000
DPRICE1	50.666667	2.935521	.973619	.250000	4.000	17.260	.0000
DPRICE2	-21.333333	2.935521	-.409945	.250000	4.000	-7.267	.0000
(Constant)	33.666667	2.075727				16.219	.0000

Collinearity Diagnostics

Number	Eigenval	Cond Index	Variance Proportions Constant	DAP1	DAP11	DAP12	DAP2	DAP21
1	3.29966	1.000	.00842	.00631	.00474	.00474	.0063	.00474
2	1.81650	1.348	.00000	.00015	.01445	.01995	.0001	.01995
3	1.81650	1.348	.00000	.02279	.01995	.01445	.0227	.01445
4	1.00000	1.816	.00000	.00000	.06	.06250	.0000	.06250
5	.33333	3.146	.00489	.12133	.00275	.00275	.1213	.00275
6	.33333	3.146	.16177	.00367	.09100	.09100	.0036	.09100
7	.18350	4.240	.00000	.00010	.17760	.16300	.0001	.16300
8	.18350	4.240	.00000	.22696	.16300	.17760	.2269	.17760
9	.03367	9.899	.82491	.61869	.46401	.46401	.6186	.46401

	DAP22	DPRICE1	DPRICE2
1	.00474	.00631	.00631
2	.01445	.02279	.02279
3	.01995	.00015	.00015
4	.06250	.00000	.00000
5	.00275	.12133	.12133
6	.09100	.00367	.00367
7	.17760	.22696	.22696
8	.16300	.00010	.00010
9	.46401	.61869	.61869

End Block Number 1 All requested variables entered.

Residuals Statistics:

	Min	Max	Mean	Std Dev	N
*PRED	12.3333	84.3333	46.2222	24.8193	27
*RESID	-4.6667	5.6667	.0000	2.9914	27
*ZPRED	-1.3654	1.5355	.0000	1.0000	27
*ZRESID	-1.2980	1.5761	.0000	.8321	27

Total Cases = 27

Durbin-Watson Test = 2.40879

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6. Quarterly data for retail car sales (RCS) for the years 1987 to 1996 were related to Disposable Personal Income (DPI) and Prime Interest Rate (PR). A portion of the data is shown below.

TIME	RCS	DPI	MR
1996.00	273792.0	2742.90	13.73
1996.00	261643.0	2692.00	14.43
	:		
	:		
1987.00	372414.0	3466.90	10.00
1987.00	369017.0	3493.00	9.82

a. SPSS regression results with RCS as the dependent and DPI and PR as the explanatory variables are as follow:

i. How good is the model? (Use the usual criteria for judging goodness of model)
ii. Are the assumptions of the regression models satisfied.
iii. What is the regression equation?
iv. If Quarter 1 1997 has DPI=3450 and PR=10.20, what is your 95% prediction interval for retail car sales (RCS)

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          * * * *   M U L T I P L E   R E G R E S S I O N   * * * *
Listwise Deletion of Missing Data
Equation Number 1    Dependent Variable..   RCS   Retail car sales
Block Number  1.  Method:  Enter      DPI      MR

Variable(s) Entered on Step Number
   1..    MR        Prime mortgage rate
   2..    DPI       Real Disposable Income

Multiple R            .99357
R Square              .98717
Adjusted R Square     .98648
Standard Error    4476.99657

Analysis of Variance
                    DF      Sum of Squares      Mean Square
Regression           2   57068532922.52700 28534266461.2635
Residual            37     741609435.44798   20043498.25535

F =     1423.61708       Signif F =  .0000

-------------------- Variables in the Equation --------------------------
Variable                  B       SE B      Beta    Tolerance     VIF          T

DPI          125.399641    5.077089   .841618     .298609    3.349     24.699
MR         -2773.581235  537.385823 -.175869     .298609    3.349     -5.161
(Constant) -38992.61095 21745.81210                                    -1.793

------ in -------
Variable      Sig T

DPI           .0000
MR            .0000
(Constant)    .0811
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Collinearity Diagnostics

Number	Eigenval	Cond Index	Variance Constant	Proportions DPI	MR
1	2.96363	1.000	.00012	.00023	.00116
2	.03570	9.111	.00112	.01951	.17955
3	.00066	66.821	.99876	.98026	.81929

End Block Number 1 All requested variables entered.

Residuals Statistics:

	Min	Max	Mean	Std Dev	N
*PRED	258560.4531	371791.7813	313416.4750	38253.0485	40
*ZPRED	-1.4340	1.5260	.0000	1.0000	40
*SEPRED	731.0881	2024.0631	1189.3041	301.8203	40
*ADJPRED	258156.8281	372060.3125	313401.1509	38286.5022	40
*RESID	-8090.5645	9008.9521	.0000	4360.6911	40
*ZRESID	-1.8071	2.0123	.0000	.9740	40
*SRESID	-1.8559	2.0691	.0016	1.0110	40
*DRESID	-8574.6426	9525.1553	15.3241	4700.2953	40
*SDRESID	-1.9223	2.1704	.0022	1.0318	40
*MAHAL	.0650	6.9965	1.9500	1.5326	40
*COOK D	.0001	.1171	.0261	.0320	40
*LEVER	.0017	.1794	.0500	.0393	40

Total Cases = 40

Durbin-Watson Test = 1.43008

b. The retail car sales may be seasonal; i.e. the changes in sales may be due to the time of the year. For this reason, dummy variables were introduced with Q1 taking value 1 for Quarter 2 and 0 otherwise; Q2 taking value 1 for Quarter 3 and 0 otherwise; and Q3 taking value 1 for Quarter 4 and 0 otherwise. For quarter 1 all three dummy variables take on value 0. Interpret the solution given below and interpret the impact of quarters on the retail car sales.

(35 marks)

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           * * * *   M U L T I P L E   R E G R E S S I O N   * * *
Listwise Deletion of Missing Data
Equation Number 1    Dependent Variable..   RCS   Retail car sales
Block Number  1.  Method:  Enter
   DPI       MR       Q1       Q2       Q3

Variable(s) Entered on Step Number
   1..    Q3
   2..    MR         Prime mortgage rate
   3..    Q2
   4..    Q1
   5..    DPI        Real Disposable Income

Multiple R            .99394
R Square              .98793
Adjusted R Square     .98615
Standard Error    4530.90420
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...8/-

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	5	57112153199.62950	11422430639.9259
Residual	34	697989158.34550	20529092.89251

F = 556.40211 Signif F = .0000

--------------- Variables in the Equation ---------------------------

Variable	B	SE B	Beta	Tolerance	VIF	T
DPI	124.765919	5.178581	.837365	.293973	3.402	24.093
MR	-2843.217449	547.085692	-.180284	.295094	3.389	-5.197
Q1	1735.037869	2032.16671	.019762	.662811	1.509	.854
Q2	2881.581194	2036.90119	.032822	.659734	1.516	1.415
Q3	1038.219241	2039.88535	.011825	.657805	1.520	.509
(Constant)	-37562.71675	22065.6792				-1.702

------ in -------

Variable	Sig T
DPI	.0000
MR	.0000
Q1	.3992
Q2	.1663
Q3	.6141
(Constant)	.0978

Collinearity Diagnostics

Number	Eigenval	Cond Index	Variance Proportions Constant	DPI	MR	Q1	Q2	Q3
1	3.76760	1.000	.00007	.00014	.00069	.00992	.00987	.00979
2	1.00009	1.941	.00000	.00000	.00000	.17866	.01574	.30026
3	1.00000	1.941	.00000	.00000	.00000	.15241	.31378	.02923
4	.19621	4.382	.00040	.00064	.00460	.65544	.65219	.64558
5	.03544	10.310	.00123	.01985	.17486	.00161	.00304	.00810
6	-.00066	75.660	.99830	.97937	.81984	.00196	.00537	.00704

Residuals Statistics:

	Min	Max	Mean	Std Dev	N
*PRED	259014.5469	371362.4688	313416.4750	38267.6650	40
*ZPRED	-1.4216	1.5142	.0000	1.0000	40
*SEPRED	1445.4250	2454.6794	1741.2522	220.4996	40
*ADJPRED	258400.2188	371789.3750	313402.8236	38291.6227	40
*RESID	-8462.2305	8617.0020	.0000	4230.5033	40
*ZRESID	-1.8677	1.9018	.0000	.9337	40
*SRESID	-2.0024	2.0416	.0014	1.0113	40
*DRESID	-9726.9951	9930.4912	13.6514	4966.6764	40
*SDRESID	-2.1004	2.1473	.0018	1.0344	40

Total Cases = 40
Durbin-Watson Test = 1.36537

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AGW 615 ADVANCED BUSINESS STATISTICS FORMULAE

1. Mean

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \cdots or \cdots \bar{x} = \frac{\sum_{i=1}^{N} x_i}{N} \cdots$$

2. Variance

$$s^2 = \frac{\sum (x - \bar{x})^2}{n-1} = \frac{\sum x^2 - n\bar{x}^2}{n-1}$$

3. Sampling Distribution

$$\mu_{\bar{x}} = \mu \cdots\cdots and \cdots\cdots \mu_{\hat{p}} = p$$

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \cdots\cdots and \cdots\cdots \sigma_{\hat{p}} = \sqrt{\frac{p(1-P)}{n}}$$

4. Confidence Interval

$$\bar{x} \pm z_{\alpha/2} \bullet \frac{\sigma}{\sqrt{n}} \cdots\cdots or \cdots\cdots \bar{x} \pm t_{\alpha/2, n-1} \bullet \frac{\sigma}{\sqrt{n}} \cdots\cdots or \cdots\cdots \hat{p} \pm z_{\alpha\ 2} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

5. Sample Sizes

$$n = \left(\frac{z_{\alpha/2}\sigma}{B}\right)^2 \cdots\cdots or \cdots\cdots n = \left(\frac{t_{\alpha/2, n-1} s}{B}\right)^2 \cdots\cdots or \cdots\cdots n = \left(\frac{z_{\alpha/2}\sqrt{p(1-p)}}{B}\right)$$

6. Sampling distribution of Differences

$$\mu_{x_1 - x_2} = \mu_1 - \mu_2 \cdots\cdots or \mu_{\hat{p}_1 - \hat{p}_2} = p_1 - p_2$$

$$\sigma_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} \cdots\cdots or \cdots\cdots s_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \cdots$$

$$df = n_1 + n_2 - 2 \cdots\cdots or \cdots\cdots df = \frac{\left(s_1^2/n_1 + s_2^2/n_2\right)^2}{\left(\frac{\left(s_1^2/n_1\right)^2}{n_1 - 1} + \frac{\left(s_2^2/n_2\right)^2}{n_2 - 1}\right)}$$

$$s_{\bar{x}_1 - \bar{x}_2} = s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}} \cdots\cdots and \cdots\cdots s_p = \sqrt{\frac{s_1^2(n_1 - 1) + s_2^2(n_2 - 1)}{n_1 + n_2 - 2}}$$

$$\sigma_{\hat{p}_1 - \hat{p}_2} = \sqrt{\frac{p_1(1 - p_1)}{n_1} + \frac{p_2(1 - p_2)}{n_2}}$$

WILCOXON RANK SUM TEST

$$E(T) = \frac{n_1(n_1 + n_2 + 1)}{2} \cdots\cdots and \cdots\cdots \sigma_T = \sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}$$

WILCOXON SIGNED RANK SUM TEST

$$E(T) = \frac{n\ (\ n\ + 1)}{2} \cdots\cdots and \cdots\cdots \sigma_T = \sqrt{\frac{n\ (n\ + 1)(2n_1 + 1)}{24}}$$

KRUSKAL-WALLIS

$$H = \left[\frac{12}{n(n+1)} \sum \frac{T_j^2}{n_j} \right] - 3(n+1)$$

FRIEDMAN

$$F_r = \left[\frac{12}{bk(k+1)} \sum T_j^2 \right] - 3b(k+1)$$

CHI-SQUARED

$$\chi^2 = \sum \frac{(o_i - e_i)^2}{e_i} \cdots\cdots where \cdots e_i = np_i$$

$$\chi^2 = \sum\sum \frac{(o_{ij} - e_{ij})^2}{e_{Ij}} \cdots\cdots where \cdots e_{ij} = \frac{T_i T_j}{N}$$

$$and \cdots\cdots T_i = row \cdots i \cdots total, \cdots and \cdots T_j = column \cdots j \cdots total$$

ANALYSIS OF VARIANCE

$$\bar{x}_j = \frac{\sum_{i=1}^{n_j} x_{ij}}{n_j} \cdots\cdots \bar{\bar{x}}_j = \frac{\sum_{j=1}^{k} \sum_{i=1}^{n_j} x_{ij}}{n}$$

$$SST = \sum_{j=1}^{k} n_j (\bar{x}_j - \bar{\bar{x}})^2 \cdots\cdots SSE = \sum_{j=1}^{k} \sum_{i=1}^{n_j} n_j (x_{ij} - \bar{x}_j)^2$$

$$SS(Total) = SSE + SST \cdots\cdots MST = \frac{SST}{k-1} \cdots\cdots MSE = \frac{SSE}{n-k} \cdots\cdots F = \frac{MST}{MSE}$$

$$SS(Total) = \sum_{j=1}^{k} \sum_{i=1}^{b} (x_{ij} - \bar{\bar{x}})^2 \cdots\cdots SST = b \sum_{j=1}^{k} \left(\bar{x}_{T_j} - \bar{\bar{x}} \right)^2$$

$$SSB = k \sum_{i=1}^{b} \left(\bar{x}_{B_i} - \bar{\bar{x}} \right)^2 \cdots\cdots SSE = \sum_{j=1}^{k} \sum_{i=1}^{b} (x_{ij} - \bar{x}_{T_j} - \bar{x}_{B_i} + \bar{\bar{x}})^2$$

$$MST = \frac{SST}{k-1} \cdots\cdots MSB = \frac{SSB}{b-1} \cdots\cdots MSE = \frac{SSE}{n-k-b+1}$$

$$SS(Total) = \sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{r}(x_{ijk} - \bar{\bar{x}})^2 \cdots\cdots SS(A) = rb\sum_{i=1}^{a}\left(\bar{x}[A]_i - \bar{\bar{x}}\right)^2$$

$$SS(B) = ra\sum_{i=1}^{b}\left(\bar{x}[B]_j - \bar{\bar{x}}\right)^2 \cdots\cdots SS(AB) = r\sum_{j=1}^{k}\sum_{i=1}^{b}(\bar{x}[AB]_{ij} - \bar{x}[A]_i - \bar{x}[B]_j + \bar{\bar{x}})^2$$

$$SSE = \sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{r}\left(x_{ijk} - \bar{x}[AB]_{ij}\right)^2$$

$$MS(A) = \frac{SS(A)}{a-1} \cdots\cdots MS(B) = \frac{SS(B)}{b-1}$$

$$MS(AB) = \frac{SS(AB)}{(a-1)(b-1)} \cdots\cdots MSE = \frac{SSE}{n-ab}$$

REGRESSION

$$y = \beta_0 + \beta_1 x \cdots\cdots \hat{\beta}_1 = \frac{SS_{xy}}{SS_x} \cdots\cdots \hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \cdot \bar{x}$$

$$SS_{xy} = \sum(x_i - \bar{x})(y_i - \bar{y}) \cdots\cdots SS_x = \sum(x_i - \bar{x})^2 = \sum x_i^2 - n\bar{x}^2$$

$$SS_y = \sum(y_i - \bar{y})^2 = \sum y_i^2 - n\bar{y}^2 \cdots\cdots\cdots SSE = SS_y - \frac{SS^2{}_{xy}}{SS_x}$$

Standard Error of Estimate & Coefficient of Determination,

$$S_\varepsilon = \sqrt{\frac{SS}{n-2}} \qquad R^2 = 1 - \frac{SSE}{SS_y}$$

Prediction and Estimation Interval at x_g

$$\hat{y} \pm t_{\alpha/2,n-2}\sqrt{1 + \frac{1}{n} + \frac{(x_g - \bar{x})^2}{SS_x}} \cdots\cdots \hat{y} \pm t_{\alpha/2,n-2}\sqrt{\frac{1}{n} + \frac{(x_g - \bar{x})^2}{SS_x}}$$

Coefficient of Correlation

$$r = \frac{SS_{xy}}{\sqrt{SS_x \cdot SS_y}} \cdots\cdots t = \sqrt{\frac{n-}{1-r^2}}$$

Spearman Rank Correlation

$$r_s = \frac{SS_{ab}}{\sqrt{SS_a \cdot SS_b}}$$

Standard Deviation of i-th residual

$$s_{r_i} = s_\varepsilon \bullet \sqrt{1 - h_i} \cdots\cdots h_i = \frac{1}{n} + \frac{(x_g - \bar{x})^2}{SS_x}$$

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