| 考試科目 | 4141統計學 | 系所別 | 統計學系 | 考試時間 | 7 月 11 日(星期三)第二節 |
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**選擇題(1-10: 5 pts; 11-15: 10 pts)** 選擇題請在答案卡上作答，否則不予計分。

**(Back pain study)** A nurse completing her master's degree thesis collected data for a random sample of 279 patients who had received treatment for low back pain. The data include the following 3 variables:

| Variable | Attribute | Description |
|---|---|---|
| Gender | F, M | Patient's gender: F=female; M=male. |
| AgeGroup | 1, 2 | Patient's age: AgeGroup is 1 if age <45; 2, if age>=45. |
| LostDays | Integer | Number of workdays lost due to low back pain last year |

1. (5 pts) Which graph is an adequate graphical tool for Gender?
   (A). Histogram
   (B). Bar chart
   (C). Box plot
   (D). Stem-and-leaf plot

2. (5 pts) Let X=the number of female patients in the sample of 279 patients. Which of the following distributions will you assume for X?
   (A). X~Normal distribution
   (B). X~Binomial distribution
   (C). X~Poisson distribution
   (D). X~Exponential distribution

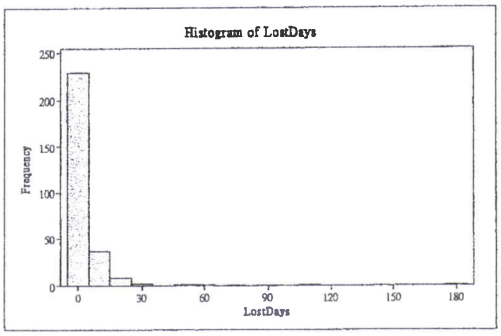
3. (5 pts) Which of the statements of a sampling distribution of the sample proportion is true?
   (A). It follows a Bernoulli distribution.
   (B). It follows a Binomial distribution.
   (C). It follows a normal distribution.
   (D). Its mean is equal to the population proportion.

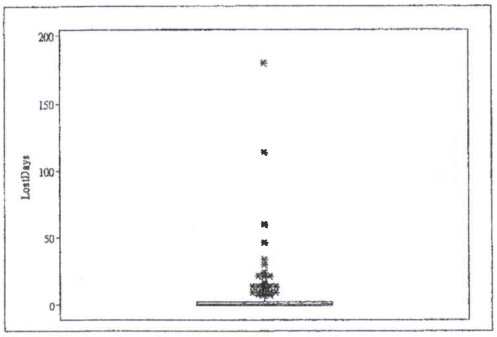
4. (5 pts) What is the standard error of a sample proportion?
   (A). Standard deviation of the population proportion.
   (B). Population standard deviation of the population proportion.
   (C). The average estimating error of the sample proportion.
   (D). Standardized error of the sample proportion.
   (E). Standardized z-value of the sample proportion to the population proportion.

| 備註 | 一、作答於試題上者，不予計分。<br>二、試題請隨卷繳交。 |
|---|---|

| 考試科目 | 4443 統計學 | 系所別 | 統計學系 | 考試時間 | 7 月 11 日(星期三)第二節 |
|---|---|---|---|---|---|

5. (5 pts) The following are the graphs of LostDays. What are the two plots?




(A). Left : Bar chat; Right : Scatter plot
(B). Left : Frequency plot; Right : Box plot
(C). Left : Bar chart; Right : dot plot
(D). Left : Histogram; Right : Box plot

6. (5 pts) (Continue Q5) Which of the following description is the least adequate for variable LostDays?
(A). Extreme outliers comes from a problematic sampling.
(B). The distribution is severely skew to the right.
(C). The sample standard deviation is affected by extreme outliers.
(D). The greater population standard deviation, the more outliers.

7. (5 pts) (Continue Q5) Which of the following distributions will you assume for LostDays?
(A). LostDays~Normal distribution.
(B). LostDays ~Binomial distribution.
(C). LostDays ~Poisson distribution.
(D). LostDays ~Uniform distribution.

8. (5 pts) Which description about the Central Limit Theorem is correct?
(A). When the population distribution is severely skewed, the theorem fails.
(B). When the sample distribution is severely skewed, the theorem fails.
(C). When the population mean is unknown, the theorem fails.
(D). None of the above.

| 備註 | 一、作答於試題上者，不予計分。<br>二、試題請隨卷繳交。 |
|---|---|

| 考試科目 | 41413 統計學 | 系所別 | 統計學系 | 考試時間 | 7 月 11 日(星期三)第二節 |
|---|---|---|---|---|---|

9. (5 pts) Which of the following cannot tell that the population distribution of the data is normal?
   (A). The sample mean is nearly 0, and the sample variance is nearly 1.
   (B). The sample distribution is bell-shaped.
   (C). The data is consistent with the empirical rule.
   (D). There are several outliers.

10. (5 pts) The following regression equation was computed from a sample of 20 observations

$$\hat{Y} = 15 - 5x.$$

SSE was found to be 100 and SS total 400. Calculate the standard error of estimate, s; the adjusted coefficient of determination, $R^2$; and the correlation coefficient, r.
   (A). s=2.36, $R^2$=0.75, r=0.866.
   (B). s=2.36, $R^2$=0.75, r=-0.866
   (C). s=2.36, $R^2$=0.736, r=0.866
   (D). s=2.36, $R^2$=0.736, r=-0.866

11. (10 pts) (Continue Q1 Back pain study) Suppose it is observed that the sample proportion of female patients among the 279 patients is 0.38, what is the 95% confidence interval of the population proportion of female patients having a low back pain?
   (A). 0.323-0.437
   (B). 0.000-0.842
   (C). 0.233-0.527
   (D). 0.322-0.438

12. (10 pts) (Continue Q1 Back pain study) Given the following statistics, calculate the p-value of testing whether the mean workdays lost due to low back pain of female patients is different with that of male patients.

| Variable | Gender | Sample size | Mean | SE Mean | StDev |
|---|---|---|---|---|---|
| LostDays | Female | 106 | 4.70 | 1.33 | 13.68 |
| | Male | 173 | 3.47 | 1.09 | 14.39 |

   (A). 0.61
   (B). 0.97
   (C). 0.68
   (D). 0.48

| 備註 | 一、作答於試題上者，不予計分。<br>二、試題請隨卷繳交。 |
|---|---|

| 考試科目 | 41413 統計學 | 系所別 | 統計學系 | 考試時間 | 7 月 11 日(星期三)第二節 |
|---|---|---|---|---|---|

13. (10pts) (Continue Q1 Back pain study) Consider a new variable, LostGroup,

$$\text{LostGroup} = \begin{cases} 0, & \text{LostDays} \le 3 \\ 1, & \text{LostDays} > 3 \end{cases}$$

The following is the cross-table of LostGroup and Age:

| | LostGroup=0 | LostGroup=1 | Total |
|---|---|---|---|
| AgeGroup=1 | 143 | 38 | 181 |
| AgeGroup=2 | 76 | 22 | 98 |
| Total | 219 | 60 | 279 |

To determine whether LostGroup is associated with AgeGroup, the p-value is

(A). Less than 0.05.

(B). Between 0.05 and 0.10.

(C). Between 0.10 and 0.25.

(D). Between 0.25 and 0.50.

(E). Greater than 0.50.

14. (10 pts) A dog trainer is exploring the relationship between the size of the dog (W, weight in pounds) and its daily food consumption (C, measured in standard cups). Below is the result of a sample of 10 observations. Develop the regression equation for cups based on the dog's weight.

| Dog | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| W | 41 | 148 | 79 | 41 | 85 | 111 | 37 | 111 | 41 | 91 |
| C | 3 | 8 | 5 | 4 | 5 | 6 | 3 | 6 | 3 | 5 |

$$\sum_{i=1}^{10} w_i = 785, \sum_{i=1}^{10} c_i = 48, \sum_{i=1}^{10} w_i^2 = 74705, \sum_{i=1}^{10} w_i c_i = 4312.$$

(A). C'=2.02+0.042W.

(B). C'=2.02+0.029W.

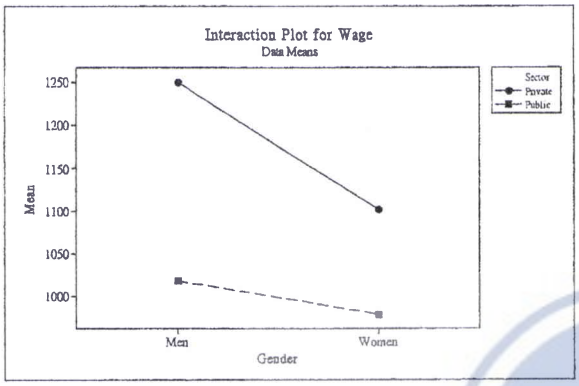
(C). C'=1.74+0.029W.

(D). C'=1.54+0.042W.

| 備註 | 一、作答於試題上者，不予計分。<br>二、試題請隨卷繳交。 |
|---|---|

| 考試科目 | 4413 統計學 | 系所別 | 統計學系 | 考試時間 | 7 月 11 日(星期三)第二節 |
|---|---|---|---|---|---|

15. (10 pts) The American Accounting Association conducted a study to compare the weekly wages of men and women employed in either the public or private sector of accounting. Random samples of 5 mean and 5 women were selected in each group. According to the following interaction plot of men and women means by sector, which is the most likely result?




(A). The main effects of Gender, Sector and their interaction are all significant.

(B). The main effects of Gender is insignificant, Sector and the interaction are significant.

(C). The main effects of Sector is insignificant, Gender and the interaction are significant.

(D). The main effect of Gender and the interaction is insignificant, while Sector is significant.

(E). The main effects of Gender, Sector and their interaction are all insignificant.

| 備註 | 一、作答於試題上者，不予計分。<br>二、試題請隨卷繳交。 |
|---|---|

| 考試科目 | 4413 統計學 | 系所別 | 統計學系 | 考試時間 | 7 月 11 日(星期三)第二節 |
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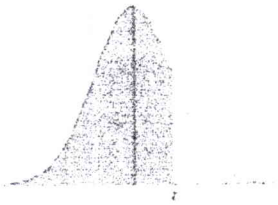
**Appendix I**

## Standard Normal Cumulative Probability Table



**Cumulative probabilities for POSITIVE z-values are shown in the following table:**

| z | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.5000 | 0.5040 | 0.5080 | 0.5120 | 0.5160 | 0.5199 | 0.5239 | 0.5279 | 0.5319 | 0.5359 |
| 0.1 | 0.5398 | 0.5438 | 0.5478 | 0.5517 | 0.5557 | 0.5596 | 0.5636 | 0.5675 | 0.5714 | 0.5753 |
| 0.2 | 0.5793 | 0.5832 | 0.5871 | 0.5910 | 0.5948 | 0.5987 | 0.6026 | 0.6064 | 0.6103 | 0.6141 |
| 0.3 | 0.6179 | 0.6217 | 0.6255 | 0.6293 | 0.6331 | 0.6368 | 0.6406 | 0.6443 | 0.6480 | 0.6517 |
| 0.4 | 0.6554 | 0.6591 | 0.6628 | 0.6664 | 0.6700 | 0.6736 | 0.6772 | 0.6808 | 0.6844 | 0.6879 |
| 0.5 | 0.6915 | 0.6950 | 0.6985 | 0.7019 | 0.7054 | 0.7088 | 0.7123 | 0.7157 | 0.7190 | 0.7224 |
| 0.6 | 0.7257 | 0.7291 | 0.7324 | 0.7357 | 0.7389 | 0.7422 | 0.7454 | 0.7486 | 0.7517 | 0.7549 |
| 0.7 | 0.7580 | 0.7611 | 0.7642 | 0.7673 | 0.7704 | 0.7734 | 0.7764 | 0.7794 | 0.7823 | 0.7852 |
| 0.8 | 0.7881 | 0.7910 | 0.7939 | 0.7967 | 0.7995 | 0.8023 | 0.8051 | 0.8078 | 0.8106 | 0.8133 |
| 0.9 | 0.8159 | 0.8186 | 0.8212 | 0.8238 | 0.8264 | 0.8289 | 0.8315 | 0.8340 | 0.8365 | 0.8389 |
| 1.0 | 0.8413 | 0.8438 | 0.8461 | 0.8485 | 0.8508 | 0.8531 | 0.8554 | 0.8577 | 0.8599 | 0.8621 |
| 1.1 | 0.8643 | 0.8665 | 0.8686 | 0.8708 | 0.8729 | 0.8749 | 0.8770 | 0.8790 | 0.8810 | 0.8830 |
| 1.2 | 0.8849 | 0.8869 | 0.8888 | 0.8907 | 0.8925 | 0.8944 | 0.8962 | 0.8980 | 0.8997 | 0.9015 |
| 1.3 | 0.9032 | 0.9049 | 0.9066 | 0.9082 | 0.9099 | 0.9115 | 0.9131 | 0.9147 | 0.9162 | 0.9177 |
| 1.4 | 0.9192 | 0.9207 | 0.9222 | 0.9236 | 0.9251 | 0.9265 | 0.9279 | 0.9292 | 0.9306 | 0.9319 |
| 1.5 | 0.9332 | 0.9345 | 0.9357 | 0.9370 | 0.9382 | 0.9394 | 0.9406 | 0.9418 | 0.9429 | 0.9441 |
| 1.6 | 0.9452 | 0.9463 | 0.9474 | 0.9484 | 0.9495 | 0.9505 | 0.9515 | 0.9525 | 0.9535 | 0.9545 |
| 1.7 | 0.9554 | 0.9564 | 0.9573 | 0.9582 | 0.9591 | 0.9599 | 0.9608 | 0.9616 | 0.9625 | 0.9633 |
| 1.8 | 0.9641 | 0.9649 | 0.9656 | 0.9664 | 0.9671 | 0.9678 | 0.9686 | 0.9693 | 0.9699 | 0.9706 |
| 1.9 | 0.9713 | 0.9719 | 0.9726 | 0.9732 | 0.9738 | 0.9744 | 0.9750 | 0.9756 | 0.9761 | 0.9767 |
| 2.0 | 0.9772 | 0.9778 | 0.9783 | 0.9788 | 0.9793 | 0.9798 | 0.9803 | 0.9808 | 0.9812 | 0.9817 |
| 2.1 | 0.9821 | 0.9826 | 0.9830 | 0.9834 | 0.9838 | 0.9842 | 0.9846 | 0.9850 | 0.9854 | 0.9857 |
| 2.2 | 0.9861 | 0.9864 | 0.9868 | 0.9871 | 0.9875 | 0.9878 | 0.9881 | 0.9884 | 0.9887 | 0.9890 |
| 2.3 | 0.9893 | 0.9896 | 0.9898 | 0.9901 | 0.9904 | 0.9906 | 0.9909 | 0.9911 | 0.9913 | 0.9916 |
| 2.4 | 0.9918 | 0.9920 | 0.9922 | 0.9925 | 0.9927 | 0.9929 | 0.9931 | 0.9932 | 0.9934 | 0.9936 |
| 2.5 | 0.9938 | 0.9940 | 0.9941 | 0.9943 | 0.9945 | 0.9946 | 0.9948 | 0.9949 | 0.9951 | 0.9952 |
| 2.6 | 0.9953 | 0.9955 | 0.9956 | 0.9957 | 0.9959 | 0.9960 | 0.9961 | 0.9962 | 0.9963 | 0.9964 |
| 2.7 | 0.9965 | 0.9966 | 0.9967 | 0.9968 | 0.9969 | 0.9970 | 0.9971 | 0.9972 | 0.9973 | 0.9974 |
| 2.8 | 0.9974 | 0.9975 | 0.9976 | 0.9977 | 0.9977 | 0.9978 | 0.9979 | 0.9979 | 0.9980 | 0.9981 |
| 2.9 | 0.9981 | 0.9982 | 0.9982 | 0.9983 | 0.9984 | 0.9984 | 0.9985 | 0.9985 | 0.9986 | 0.9986 |
| 3.0 | 0.9987 | 0.9987 | 0.9987 | 0.9988 | 0.9988 | 0.9989 | 0.9989 | 0.9989 | 0.9990 | 0.9990 |
| 3.1 | 0.9990 | 0.9991 | 0.9991 | 0.9991 | 0.9992 | 0.9992 | 0.9992 | 0.9992 | 0.9993 | 0.9993 |
| 3.2 | 0.9993 | 0.9993 | 0.9994 | 0.9994 | 0.9994 | 0.9994 | 0.9994 | 0.9995 | 0.9995 | 0.9995 |
| 3.3 | 0.9995 | 0.9995 | 0.9995 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9997 |
| 3.4 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9998 |

| 備註 | 一、作答於試題上者，不予計分。<br>二、試題請隨卷繳交。 |
|---|---|

| 考試科目 | 4413 統計學 | 系所別 | 統計學系 | 考試時間 | 7 月 11 日(星期三)第二節 |
|---|---|---|---|---|---|

**Appendix II**

**Percentage Points of the Chi-Square Distribution**

| Degrees of Freedom | Probability of a larger value of $x^2$ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0.99 | 0.95 | 0.90 | 0.75 | 0.50 | 0.25 | 0.10 | 0.05 | 0.01 |
| 1 | 0.000 | 0.004 | 0.016 | 0.102 | 0.455 | 1.32 | 2.71 | 3.84 | 6.63 |
| 2 | 0.020 | 0.103 | 0.211 | 0.575 | 1.386 | 2.77 | 4.61 | 5.99 | 9.21 |
| 3 | 0.115 | 0.352 | 0.584 | 1.212 | 2.366 | 4.11 | 6.25 | 7.81 | 11.34 |
| 4 | 0.297 | 0.711 | 1.064 | 1.923 | 3.357 | 5.39 | 7.78 | 9.49 | 13.28 |
| 5 | 0.554 | 1.145 | 1.610 | 2.675 | 4.351 | 6.63 | 9.24 | 11.07 | 15.09 |
| 6 | 0.872 | 1.635 | 2.204 | 3.455 | 5.348 | 7.84 | 10.64 | 12.59 | 16.81 |
| 7 | 1.239 | 2.167 | 2.833 | 4.255 | 6.346 | 9.04 | 12.02 | 14.07 | 18.48 |
| 8 | 1.647 | 2.733 | 3.490 | 5.071 | 7.344 | 10.22 | 13.36 | 15.51 | 20.09 |
| 9 | 2.088 | 3.325 | 4.168 | 5.899 | 8.343 | 11.39 | 14.68 | 16.92 | 21.67 |
| 10 | 2.558 | 3.940 | 4.865 | 6.737 | 9.342 | 12.55 | 15.99 | 18.31 | 23.21 |
| 11 | 3.053 | 4.575 | 5.578 | 7.584 | 10.341 | 13.70 | 17.28 | 19.68 | 24.72 |
| 12 | 3.571 | 5.226 | 6.304 | 8.438 | 11.340 | 14.85 | 18.55 | 21.03 | 26.22 |
| 13 | 4.107 | 5.892 | 7.042 | 9.299 | 12.340 | 15.98 | 19.81 | 22.36 | 27.69 |
| 14 | 4.660 | 6.571 | 7.790 | 10.165 | 13.339 | 17.12 | 21.06 | 23.68 | 29.14 |
| 15 | 5.229 | 7.261 | 8.547 | 11.037 | 14.339 | 18.25 | 22.31 | 25.00 | 30.58 |
| 16 | 5.812 | 7.962 | 9.312 | 11.912 | 15.338 | 19.37 | 23.54 | 26.30 | 32.00 |
| 17 | 6.408 | 8.672 | 10.085 | 12.792 | 16.338 | 20.49 | 24.77 | 27.59 | 33.41 |
| 18 | 7.015 | 9.390 | 10.865 | 13.675 | 17.338 | 21.60 | 25.99 | 28.87 | 34.80 |
| 19 | 7.633 | 10.117 | 11.651 | 14.562 | 18.338 | 22.72 | 27.20 | 30.14 | 36.19 |
| 20 | 8.260 | 10.851 | 12.443 | 15.452 | 19.337 | 23.83 | 28.41 | 31.41 | 37.57 |
| 22 | 9.542 | 12.338 | 14.041 | 17.240 | 21.337 | 26.04 | 30.81 | 33.92 | 40.29 |
| 24 | 10.856 | 13.848 | 15.659 | 19.037 | 23.337 | 28.24 | 33.20 | 36.42 | 42.98 |
| 26 | 12.198 | 15.379 | 17.292 | 20.843 | 25.336 | 30.43 | 35.56 | 38.89 | 45.64 |
| 28 | 13.565 | 16.928 | 18.939 | 22.657 | 27.336 | 32.62 | 37.92 | 41.34 | 48.28 |
| 30 | 14.953 | 18.493 | 20.599 | 24.478 | 29.336 | 34.80 | 40.26 | 43.77 | 50.89 |
| 40 | 22.164 | 26.509 | 29.051 | 33.660 | 39.335 | 45.62 | 51.80 | 55.76 | 63.69 |
| 50 | 27.707 | 34.764 | 37.689 | 42.942 | 49.335 | 56.33 | 63.17 | 67.50 | 76.15 |
| 60 | 37.485 | 43.188 | 46.459 | 52.294 | 59.335 | 66.98 | 74.40 | 79.08 | 88.38 |

| 備註 | 一、作答於試題上者，不予計分。<br>二、試題請隨卷繳交。 |
|---|---|

| 考試科目 | 21614、41114、41214、微積分 41414、41514、41614、41814 系所別 | 商院共同科、經濟學系 | 考試時間 | 7 月 11 日(三) 第 四 節 |
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1. (20 pts) Find the following limits. Show your work.

   (a) (5 pts) $\lim_{x\to\infty} \dfrac{\sin(x)}{x}$.

   (b) (5 pts) $\lim_{h\to 0} \dfrac{(2+h)\cos(2+h) - 2\cos(2)}{h}$.

   (c) (5 pts) $\lim_{x\to\infty} \dfrac{\int_1^x \ln(t)dt}{\int_1^x t\ln(t)dt}$.

   (d) (5 pts) $\lim_{n\to\infty} \dfrac{1}{n}\sum_{k=1}^{n} \ln\left(1+\dfrac{2k}{n}\right)$.

2. (20 pts) Find the following integrals.

   (a) (5 pts) $\int_0^{\pi} \sin(x)dx$.

   (b) (5 pts) $\int_0^1 (2x+3)^{1/2}dx$.

   (c) (5 pts) $\int_0^1 x\ln(x)dx$.

   (d) (5 pts) $\int_D (2x+3y)d(x,y)$, where $D = \{(x,y) : |x| + |y| \le 1\}$.

3. (20 pts) Determine whether each of the following series converges. Justify your answers.

   (a) (5 pts) $\sum_{n=1}^{\infty} \left(1+\dfrac{1}{n}\right)^n$.

   (b) (5 pts) $\sum_{n=1}^{\infty} \dfrac{\sin(n+1)}{n^2}$.

   (c) (5 pts) $\sum_{n=1}^{\infty} \dfrac{\ln(n)}{n^{1.2}}$.

   (d) (5 pts) $\sum_{n=1}^{\infty} \dfrac{(n!)^2}{(2n)!}$.

4. (20 pts) Let $f(x) = \sin(x)/x$ for $x \neq 0$ and $g(x) = x\cos(x) - \sin(x)$ for $x \in (-\infty, \infty)$.

   (a) (5 pts) Is it possible to define $f(0)$ so that $f$ is differentiable at 0? Justify your answer.

| 備　　註 | 一、作答於試題上者，不予計分。<br>二、試題請隨卷繳交。 |
|---|---|

| 考試科目 | 21614, 41114, 41214, 微積分 41414, 41514, 41614, 41814 | 系所別 | 商院共同科、經濟學系 | 考試時間 | 7 月 11 日(三) 第 四 節 |
|---|---|---|---|---|---|

(b) (5 pts) Suppose that $I$ is an open interval and $I \subset (0, \infty)$. Show that if $g(x) > 0$ for $x \in I$, then $f$ is increasing on $I$.

(c) (5 pts) Show that $g$ is decreasing on $(0, \pi/2)$.

(d) (5 pts) Suppose that $f(0)$ is defined so that $f$ is continuous at 0. Does $f$ have a relative maximum at 0? Justify your answer.

5. (20 pts) Let $D = \{(x, y) : 1 \leq x^2 + y^2 \leq 2, x \geq 0 \text{ and } y \geq 0\}$ and

$$f(x, y) = \begin{cases} xy/(x^2 + y^2), & \text{if } x^2 + y^2 > 0; \\ 0, & \text{otherwise.} \end{cases}$$

(a) (5 pts) Determine whether $f$ is continuous at $(0, 1)$. Justify your answer.

(b) (5 pts) Find $f_y(0, 0)$.

(c) (5 pts) Find $\int_D f(x, y) d(x, y)$.

(d) (5 pts) Does $f$ have a relative minimum at $(0, 0)$? Justify your answer.

| 備 註 | 一、作答於試題上者，不予計分。<br>二、試題請隨卷繳交。 |
|---|---|