**PRINCE SULTAN UNIVERSITY**
**Department of Mathematical Sciences**
**Second Mid-Term Examination**
**First Semester (2007–2008)**
**STAT 271**

| | | | |
|---|---|---|---|
| Student Name: | | | |
| Student Number: | | Section Number: | |
| Teacher Name: | | Attendance Number: | |

| Mark |
|---|
| ____ |
| 20 |

- Time allowed is 1½ hours.
- Write down your answer in the space provided underneath the question.
- Numbers within brackets [#] are the marks.
- You may use a programmable calculator and/or the attached formula sheet.

| $Z_{0.10}$ | $Z_{0.05}$ | $Z_{0.025}$ | $Z_{0.01}$ | $Z_{0.005}$ |
|---|---|---|---|---|
| 1.285 | 1.645 | 1.96 | 2.325 | 2.575 |

---

**Question 1:**

A company is interested in comparing the current year's sales revenue per invoice with the last year. The mean revenue per invoice for the last year was \$5.5. From the sales invoices of the current year to date, the management randomly selected n=400 invoices and summarized some information of the revenues of these invoices in the following table:

| Data Summary | | | |
|---|---|---|---|
| $n = 400$ | $\sum_{i=1}^{400} x_i = 2401.19$ | $\sum_{i=1}^{400} x_i^2 = 14651.1$ | $\sum_{i=1}^{400} (x_i - \bar{x})^2 = 236.81646$ |

Do these data indicate that the mean revenue per invoice for the current year is larger than the mean revenue per invoice for the last year? Use $\alpha = 0.01$. (Your discussion should include the null and the alternative hypotheses, the value of the test statistic, the rejection region, and your conclusion.)

**Question 2:**

Two random samples of sizes $n_1=21$ and $n_2=11$ observations were selected independently from two normal populations with equal variances. The following results were obtained:

| | 1st Sample | 2nd Sample |
|---|---|---|
| Sample size ( $n$ ) | 21 | 11 |
| Sample mean ( $\overline{X}$ ) | 35 | 32 |
| Sample variance ( $S^2$ ) | 5 | 6 |

(a) Do these data indicate that there is a difference between the means of the two normal populations? Use $\alpha=0.05$ (Your discussion should include the null and the alternative hypotheses, the value of the test statistic, the rejection region, and your conclusion.)

(b) Construct a 95% confidence interval for $\mu_1-\mu_2$.

**Question 3:**

In an experiment to determine the effect of nutrition on the attention spans of students, 9 students were randomly selected from the school and randomly divided into three groups; each group received three students. Each group was randomly assigned to one of three meal plans (no breakfast, light breakfast, and full breakfast). The students' attention spans (in minutes) were recorded during a morning reading period and are shown in the following table:

| | No breakfast | Light breakfast | Full breakfast |
|---|---|---|---|
| Observations | 8<br>9<br>10 | 14<br>15<br>17 | 10<br>14<br>12 |
| $n_i$ | 3 | 3 | 3 |
| Sum= $T_i = \sum_{i=1}^{n_i} x_i$ | 27 | 46 | 36 |
| Sum of squares= $\sum_{i=1}^{n_i} x_i^2$ | 245 | 710 | 440 |

Complete the following the ANOVA table:

| Source of Variation | SS | df | MS | F-ratio | F-crit |
|---|---|---|---|---|---|
| Between Groups (Treatment) | | | | | |
| Within Groups (Error) | | | | XXX | XXX |
| Total | | | XXX | XXX | XXX |

**Question 4:**

In a similar experiment to determine the effect of nutrition on the attention spans of students, 60 students were randomly selected from the school and randomly divided into three groups; each group received 20 students. Each group was randomly assigned to one of three meal plans (no breakfast, light breakfast, and full breakfast). The students' attention spans (in minutes) were recorded during a morning reading period. The ANOVA table of this experiment is given below:

ANOVA

| *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
|---|---|---|---|---|---|---|
| Between Groups (Treatment) | **SST** | 2 | **MST** | 10.42197 | 0.00014 | 3.1588 |
| Within Groups (Error) | **SSE** | $df_{SSE}$ | 2.384359 | | | |
| Total | 185.60792 | 59 | | | | |

(a) Find the value of SST (treatment sum of squares).

(b) Find the value of SSE (error sum of squares).

(c) Find $df_{SSE}$ .

(d) Find the value of MST (treatment mean squares).

(e) Do the data provide sufficient evidence to indicate a difference in the mean attention spans depending on the type of breakfast eaten by the student? Use $\alpha$=0.01.