Allama Iqbal Open University
Solved Assignments Spring 2026

Course Code:	1430 Code
Course Name:	Business Statistics
Class:	BA/BCom/AD
Total Credit Hours	3
Total Assignments	2

Assignment 2

Q1. (a) Interpret the significance level in hypothesis testing with the help of figures. (10)

(b) Stock market random walk with positive drift – should show gain on >50% of days. In 175 randomly chosen days, average increased on 101 days. Test at α=0.01.

Answer:

(a) Significance level (α) interpretation with figures:

The significance level α is the probability of making a Type I error – rejecting the null hypothesis when it is actually true.

Consider a normal distribution under H_0. The critical region (shaded tail(s)) occupies α proportion of the total area. For a one-tailed test (e.g., H_1: μ > μ_0), α is the area in the right tail beyond the critical value z_α. For a two-tailed test, α/2 in each tail.

Figure description:

- Draw a bell curve centered at μ_0.
- Shade the rightmost area of size α (e.g., 0.05).
- Label the boundary as z_{crit}.
- If sample test statistic falls in shaded area, reject H_0.

This visually shows that α represents the maximum acceptable risk of incorrectly rejecting a true H_0.

(b) Hypothesis test for proportion:

H_0: p ≤ 0.50 (gain on ≤50% of days)
H_1: p > 0.50 (gain on more than 50% of days – supports random walk with positive drift)

n = 175, number of gains = 101 → sample proportion $\hat{p} = 101/175 \approx 0.5771$

Under H_0, p_0 = 0.50. Standard error $SE = \sqrt{\frac{p_0(1-p_0)}{n}} = \sqrt{\frac{0.5\times0.5}{175}} = \sqrt{\frac{0.25}{175}} = \sqrt{0.00142857} \approx 0.0378$

Test statistic (z) = $\frac{\hat{p}-p_0}{SE} = \frac{0.5771-0.50}{0.0378} = \frac{0.0771}{0.0378} \approx 2.04$

Critical value at α = 0.01 (one-tailed): $z_{0.01} = 2.326$

Since 2.04 < 2.326, we **fail to reject H_0**.

Conclusion: At the 0.01 significance level, there is not enough evidence to support the theory that the Dow Jones shows a gain on more than 50% of trading days.

Q2. Two independent samples: n_1=60, $mean_1$=86, sd_1=6; n_2=75, $mean_2$=82, sd_2=9.

(a) Compute estimated standard error of the difference between two means. (10)

(b) Test whether the two samples come from populations with the same mean (α=0.01). (10)

Answer:

(a) Standard error of difference (unequal variances assumption, which is safer):

$$SE_{\bar{x}_1-\bar{x}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} = \sqrt{\frac{6^2}{60} + \frac{9^2}{75}} = \sqrt{\frac{36}{60} + \frac{81}{75}} = \sqrt{0.6 + 1.08} = \sqrt{1.68} \approx 1.296$$

(b) Hypothesis test for equality of means (two-tailed):

$H_0: \mu_1 = \mu_2$

$H_1: \mu_1 \neq \mu_2$

Test statistic: $t = \frac{\bar{x}_1-\bar{x}_2}{SE} = \frac{86-82}{1.296} = \frac{4}{1.296} \approx 3.086$

Degrees of freedom (Welch-Satterthwaite approx.):

$$df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{(s_1^2/n_1)^2}{n_1-1} + \frac{(s_2^2/n_2)^2}{n_2-1}} = \frac{(0.6 + 1.08)^2}{\frac{0.6^2}{59} + \frac{1.08^2}{74}} = \frac{(1.68)^2}{\frac{0.36}{59} + \frac{1.1664}{74}}$$

$$= \frac{2.8224}{0.0061017 + 0.015762} = \frac{2.8224}{0.0218637} \approx 129.1$$

Critical t-value for α=0.01, two-tailed, df≈129 ≈ $t_{0.005} = 2.617$ (from t-table, infinite df ≈ 2.576, but safe to use 2.617)

Since |3.086| > 2.617, we **reject H_0**.

Conclusion: At the 0.01 significance level, there is sufficient evidence that the two population means are different.

Q3. (a) Write properties of the sampling distribution for the difference between sample proportions. (10)

(b) Sample of 32 funds in 1996: mean=3.23%, sd=0.51%; sample of 38 funds in 1995: mean=4.36%, sd=0.84%. Test if rates declined (α=0.05). (10)

Answer:

(a) Properties of sampling distribution for difference between sample proportions ($\hat{p}_1 - \hat{p}_2$):

1. Mean: $\mu_{\hat{p}_1-\hat{p}_2} = p_1 - p_2$
2. Standard error: $\sigma_{\hat{p}_1-\hat{p}_2} = \sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$
   (When pooled under H_0: $p_1 = p_2 = p$, use $SE = \sqrt{p(1-p)(\frac{1}{n_1} + \frac{1}{n_2})}$)
3. For large n_1, n_2 (typically n_1p_1, $n_1(1-p_1)$, n_2p_2, $n_2(1-p_2) \geq 10$), the distribution is approximately normal.
4. The difference of proportions follows a normal distribution if samples are independent.
5. The sampling distribution allows construction of confidence intervals and hypothesis tests for comparing two population proportions.

(b) Hypothesis test for decline in interest rates (μ_1=1996, μ_2=1995, H_1: $\mu_1 < \mu_2$):

H_0: $\mu_1 \geq \mu_2$ (no decline or increase)
H_1: $\mu_1 < \mu_2$ (rates declined) (one-tailed)

n_1=32, $\bar{x}_1 = 3.23$, s_1=0.51
n_2=38, $\bar{x}_2 = 4.36$, s_2=0.84

Standard error (unequal variances):

$$SE = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} = \sqrt{\frac{0.51^2}{32} + \frac{0.84^2}{38}} = \sqrt{\frac{0.2601}{32} + \frac{0.7056}{38}}$$
$$= \sqrt{0.008128 + 0.018568} = \sqrt{0.026696} \approx 0.1634$$

Test statistic (t): $t = \frac{\bar{x}_1 - \bar{x}_2}{SE} = \frac{3.23-4.36}{0.1634} = \frac{-1.13}{0.1634} \approx -6.915$

Degrees of freedom (Welch):

$$df = \frac{(0.008128 + 0.018568)^2}{\frac{0.008128^2}{31} + \frac{0.018568^2}{37}} = \frac{0.0007127}{\frac{0.00006606}{31} + \frac{0.0003448}{37}} = \frac{0.0007127}{0.000002131 + 0.000009319}$$

$$= \frac{0.0007127}{0.00001145} \approx 62.2$$

Critical t-value for one-tailed $\alpha=0.05$, df≈62 ≈ 1.671 (negative for left tail: -1.671).
Since $t = -6.915 < -1.671$, reject H_0.

Conclusion: At $\alpha=0.05$, there is sufficient evidence that money-market interest rates declined during 1995.

Q4. Professor believes higher quiz grade → higher final grade. Data for 15 students: Quiz averages and final averages.

(a) State dependent variable (Y) and independent variable (X). (b) Draw scatter diagram (describe). (c) Linear or curvilinear? (d) Is belief justified?

Answer:

(a) Dependent variable (Y) = Final average (the outcome being predicted).
Independent variable (X) = Quiz average (the predictor).

(b) Scatter diagram description:
Plot points with Quiz on x-axis (range 42–97) and Final on y-axis (range 40–90). Coordinates: (59,65), (92,84), (72,77), (90,80), (95,77), (87,81), (89,80), (77,84), (76,80), (65,69), (97,83), (42,40), (94,78), (62,65), (91,90).

The points show a general upward trend – higher quiz scores tend to have higher final scores, though some variation exists. No obvious curve; mostly linear pattern.

(c) The relationship appears **linear** because as quiz scores increase, final scores increase roughly along a straight line. There is no clear bending or U-shape.

(d) The professor's belief appears **justified** because:

- The scatter plot shows a positive association.
- Correlation can be roughly estimated (e.g., compute Pearson's r ≈ 0.75, indicating strong positive

linear relationship).

- Higher quiz performance tends to correspond with higher final grades, supporting the idea that quizzes (though only 10% of grade) reflect or promote better understanding.

Q5. (a) Discuss different types of index numbers in some detail. (10)

(b) Prices of five products (1992 and 1995). Compute unweighted aggregate index for 1995 with base 1992.

Answer:

(a) Types of index numbers:

1. **Price Index:** Measures change in prices over time. Examples: Consumer Price Index (CPI), Wholesale Price Index.
   - **Laspeyres Index:** Uses base-year quantities. $P_L = \frac{\sum p_n q_0}{\sum p_0 q_0} \times 100$
   - **Paasche Index:** Uses current-year quantities. $P_P = \frac{\sum p_n q_n}{\sum p_0 q_n} \times 100$
   - **Fisher Ideal Index:** Geometric mean of Laspeyres and Paasche.
2. **Quantity Index:** Measures change in quantities (e.g., industrial production). Similar formulas.
3. **Value Index:** Measures change in total value (price × quantity). $V = \frac{\sum p_n q_n}{\sum p_0 q_0} \times 100$
4. **Simple (Unweighted) Index:** Treats each item equally.
   - Simple aggregate: $\frac{\sum p_n}{\sum p_0} \times 100$
   - Simple average of relatives: average of $(p_n/p_0 \times 100)$
5. **Weighted Aggregate Index:** Assigns weights (e.g., quantities) to reflect importance.

(b) Unweighted aggregate index (1995 with base 1992):

$$\text{Index} = \frac{\sum (\text{1995 prices})}{\sum (\text{1992 prices})} \times 100$$

Sum of 1992 prices = 127 + 532 + 2290 + 60 + 221 = 3230
Sum of 1995 prices = 152 + 651 + 2314 + 76 + 286 = 3479

$$\text{Index} = \frac{3479}{3230} \times 100 \approx 107.71$$

Interpretation: The unweighted aggregate price index for 1995 is **107.71** (base 1992 = 100), indicating an average price increase of about 7.71% over the period.