PRACTICE WORKSHEET

Practice Information & Guidelines

- **Time:** 45 minutes
- **Purpose:** This practice set is designed to familiarize you with the structure and time management required for the written test.
- ***Warning(!!): The specific topics and questions included here do not indicate or restrict the content of the formal written test.***
- **If the duration of the written test is changed, you will be informed as soon as possible.**

SECTION 1: Diagnostic True / False Statements

*Instructions: Select whether each statement is **True (T)** or **False (F)**. For any statement identified as **False**, provide a concise mathematical or conceptual justification in the box provided (max 2 lines).*

Statement 1.1

In a right-skewed (positively skewed) empirical distribution, the arithmetic mean ($\bar{x}$) is typically smaller than the median (Me).

Selection: `[ ] TRUE [ ] FALSE`

None

`Justification (if False):`

Statement 1.2

An empirical cumulative frequency distribution function $F(x)$ is defined as a non-decreasing step function bounded within the interval $[0, 1]$.

Selection: [ ] TRUE [ ] FALSE

None
Justification (if False):

Statement 1.3

The sample variance (s^2), expressed in squared unit dimensions, can be directly compared with the sample mean ($\bar{x}$) to evaluate relative dispersion across datasets measured in different physical units.

Selection: [ ] TRUE [ ] FALSE

None
Justification (if False):

Statement 1.4

The coefficient of determination (R^2) in a simple linear regression model quantifies the proportion of total variation in the dependent variable explained by the fitted regression model.

Selection: [ ] TRUE [ ] FALSE

None
Justification (if False):

Statement 1.5

A quantity index computed using the Laspeyres method holds input or output prices constant at their current-period values (p_{kt}).

Selection: [ ] TRUE [ ] FALSE

```
None
Justification (if False):
```

SECTION 2: Short Answer & Mathematical Proofs

Instructions: Answer the following questions clearly and show all intermediate mathematical steps where required.

Question 2.1

Distinguish between **nominal variables** and **ordinal variables**. Provide one concrete economic or business-related example for each classification type.

```
None
Response Box:
```

Question 2.2

Define **Pearson's Linear Correlation Coefficient** (r_{xy}) between two quantitative variables X and Y.

1. State its mathematical range of values.
2. Explain what a value of $r_{xy} = -0.85$ signifies regarding both the **strength** and **direction** of the linear association.

```
None
Response Box:
```

Question 2.3

Consider the sample variance formula for a dependent variable y:

$$s_y^2 = \frac{1}{n}\sum_{i=1}^{n}(y_i - \bar{y})^2$$

Using the simple linear regression identity $(y_i - \bar{y}) = (\hat{y}_i - \bar{y}) + e_i$, demonstrate step-by-step how the total sample variance decomposes into explained variance ($s^2_{\hat{y}}$) and residual variance (s_e^2):

$$s_y^2 = s^2_{\hat{y}} + s_e^2$$

(Hint: Recall the key mathematical property $\sum_{i=1}^{n}(\hat{y}_i - \bar{y})e_i = 0$*.)*

None

```
Proof / Derivation Box:
```

SECTION 3: Applied Quantitative Analysis

Instructions: Solve the following analytical problems. Show all explicit calculations and state your conclusions clearly.

Problem 3.1

A human resources department recorded the distribution of weekly working hours across a sample of $N = 100$ staff members:

Working Hours Interval (Hours)	Frequency (n_j)
$[20, 30)$	15
$[30, 40)$	60
$[40, 50)$	25
Total	100

Tasks:

1. Compute the sample mean ($\bar{x}$) and the sample median (Me) for these grouped data.
2. Based on your computed summary measures, provide a brief commentary on the symmetry and skewness of the working hours distribution.

```
None
Solution & Analysis Box:
```

Problem 3.2

An economic research group tracks an industrial production index series. Due to structural updates, the base period needs to be re-referenced from **Year 0** to **Year 2** ($b = 2$).

The original index series based in Year 0 ($I_{t|0}$) is given below:

Period (t)	Original Index
Year 0	100.0
Year 1	115.0
Year 2	125.0
Year 3	140.0

Period (t)	Original Index
Year 4	150.0

Shift the base period of the index series to Year 2 ($b = 2$) such that $I_{2|2} = 100.0$, and calculate the new re-referenced index values ($I_{t|2}$) for all periods $t = 0, 1, 2, 3, 4$. Calculate the percentage change in industrial production between Year 2 and Year 4 using: The original index series ($I_{t|0}$) and the newly re-referenced index series ($I_{t|2}$). Comment briefly on whether re-referencing the base year alters the implied growth rate between these two periods.

None

```
Solution & Analysis Box:
```