Certainly! Let's break down each question, explain the underlying statistical concepts, provide additional examples, and guide you through the topics step-by-step.

**Question 1: Simple Linear Regression**

**Topic:** Regression Analysis  
**Purpose:** To predict a dependent variable (exam score) using an independent variable (hours of study).

**a) Regression Equation**

From the SPSS output:

* **Intercept (Constant)** = 48.321
* **Slope (Hours\_Study)** = 3.221

**Regression Equation:**

Exam Score=48.321+3.221×(Hours\_Study)Exam Score=48.321+3.221×(Hours\_Study)

**Interpretation:** For every additional hour studied, the exam score increases by 3.221 points.

**b) Correlation Coefficient (R = 0.832)**

* **Interpretation:** A strong positive correlation exists between study hours and exam scores.

**c) Hypothesis Testing for Slope**

* **Null Hypothesis (H₀):** Slope = 0 (no relationship)
* **Alternative Hypothesis (H₁):** Slope ≠ 0 (relationship exists)
* **Decision:** Since Sig. (p-value) = 0.000 < 0.05, reject H₀.

**d) Variance Explained (R² = 0.692)**

* **69.2%** of exam score variation is explained by study hours.

**Additional Example 1 (Regression)**

**Scenario:** A company wants to predict sales (Y) based on advertising spend (X).  
**SPSS Output:**

* Intercept = 50, Slope = 2.5, R² = 0.64  
  **Regression Equation:**

Sales=50+2.5×(Advertising Spend)Sales=50+2.5×(Advertising Spend)

**Interpretation:** Every $1 increase in advertising leads to a $2.5 increase in sales.

**Additional Example 2 (Regression)**

**Scenario:** Predicting house prices (Y) based on square footage (X).  
**SPSS Output:**

* Intercept = 100,000, Slope = 200, R² = 0.75  
  **Regression Equation:**

Price=100,000+200×(Square Footage)Price=100,000+200×(Square Footage)

**Interpretation:** Each additional square foot increases price by $200.

**Question 2: Chi-Square Test of Independence**

**Topic:** Categorical Data Analysis  
**Purpose:** To test if gender and learning style preference are independent.

**a) Hypotheses**

* **H₀:** No association between gender and learning style.
* **H₁:** Association exists.

**b) Chi-Square Statistic (9.417, df = 2)**

* **df = (rows - 1) × (columns - 1) = (2-1)(3-1) = 2**

**c) Significance (p = 0.009 < 0.05)**

* Reject H₀; association exists.

**d) Females Prefer Auditory (25/55)**

* Females have higher counts in Auditory learning.

**Additional Example 1 (Chi-Square)**

**Scenario:** Testing if car color (Red, Blue, Green) is associated with accident rate (Yes/No).  
**SPSS Output:**

* Chi-square = 6.5, df = 2, p = 0.039  
  **Conclusion:** Association exists (p < 0.05).

**Additional Example 2 (Chi-Square)**

**Scenario:** Is smoking (Yes/No) associated with lung disease (Yes/No)?  
**SPSS Output:**

* Chi-square = 15.2, df = 1, p = 0.000  
  **Conclusion:** Strong association (p < 0.05).

**Question 3: Independent Samples T-Test**

**Topic:** Comparing Two Means  
**Purpose:** To test if male and female exam scores differ significantly.

**a) Hypotheses**

* **H₀:** Mean scores (Male = Female)
* **H₁:** Mean scores (Male ≠ Female)

**b) Mean Difference (81.6 - 76.4 = 5.2)**

* Females scored 5.2 points higher on average.

**c) Significance (p = 0.025 < 0.05)**

* Reject H₀; significant difference.

**d) Interpretation:** Females perform better than males.

**Additional Example 1 (T-Test)**

**Scenario:** Comparing test scores of students who took a prep course vs. those who didn’t.  
**SPSS Output:**

* Mean (Prep) = 85, Mean (No Prep) = 78, p = 0.012  
  **Conclusion:** Prep course improves scores (p < 0.05).

**Additional Example 2 (T-Test)**

**Scenario:** Comparing productivity of employees working from home vs. office.  
**SPSS Output:**

* Mean (Home) = 90, Mean (Office) = 82, p = 0.043  
  **Conclusion:** Remote workers are more productive (p < 0.05).

**Question 4: One-Sample T-Test**

**Topic:** Testing a Single Mean  
**Purpose:** To check if the sample mean differs from the teacher’s claim (µ = 75).

**Hypotheses:**

* **H₀:** µ = 75
* **H₁:** µ ≠ 75

**Test Statistic Calculation:**

t=Xˉ−μs/n=74.4−753.25/10=−0.585*t*=*s*/*n*​*X*ˉ−*μ*​=3.25/10​74.4−75​=−0.585

**Critical t (α=0.05, df=9):** ±2.262  
**Decision:** |t| = 0.585 < 2.262 → Fail to reject H₀.

**Conclusion:** No evidence to reject the teacher’s claim.

**Additional Example 1 (One-Sample T-Test)**

**Scenario:** A bakery claims its cookies weigh 10g on average. A sample of 15 cookies has mean = 9.8g, s = 0.5.  
**Test:**

t=9.8−100.5/15=−1.55*t*=0.5/15​9.8−10​=−1.55

**Critical t (α=0.05, df=14):** ±2.145  
**Conclusion:** Fail to reject H₀ (no evidence against claim).

**Additional Example 2 (One-Sample T-Test)**

**Scenario:** A manufacturer claims batteries last 100 hours. A sample of 20 batteries has mean = 98, s = 5.  
**Test:**

t=98−1005/20=−1.79*t*=5/20​98−100​=−1.79

**Critical t (α=0.05, df=19):** ±2.093  
**Conclusion:** Fail to reject H₀.

**Summary of Topics**

1. **Regression:** Predicts a continuous outcome using predictor variables.
2. **Chi-Square:** Tests relationships between categorical variables.
3. **Independent T-Test:** Compares means of two independent groups.
4. **One-Sample T-Test:** Tests if a sample mean matches a known value.

Let me know if you'd like further clarification or more examples!

**Question 1: Regression Analysis**

**Context:**

A simple linear regression was conducted to determine if **hours of study per week** predict **exam scores**.

**a) Write the regression equation based on the output.**

The general form of a simple linear regression equation is:

Y^=b0+b1X\hat{Y} = b\_0 + b\_1 XY^=b0​+b1​X

Where:

* Y^\hat{Y}Y^ = Predicted exam score
* b0b\_0b0​ = Intercept (constant)
* b1b\_1b1​ = Slope (coefficient for hours of study)
* XXX = Hours of study per week

**From the SPSS output:**

* Intercept (b0b\_0b0​) = 48.321
* Slope (b1b\_1b1​) = 3.221

So, the regression equation is:

Y^=48.321+3.221⋅(Hours of Study)\hat{Y} = 48.321 + 3.221 \cdot (\text{Hours of Study})Y^=48.321+3.221⋅(Hours of Study)

**b) What is the value of correlation coefficient? Interpret it.**

* The correlation coefficient R=0.832R = 0.832R=0.832

**Interpretation:**

* The correlation coefficient (R) measures the strength and direction of a linear relationship between two variables.
* R=0.832R = 0.832R=0.832 indicates a **strong positive linear relationship** between hours of study and exam scores.
* As hours of study increase, exam scores tend to increase.

**c) Write down the hypothesis steps for the significance of the slope coefficient.**

This is a test to see whether **hours of study significantly predict exam scores**, i.e., whether the slope is significantly different from zero.

**Step 1: State the hypotheses**

* Null hypothesis H0H\_0H0​: β1=0\beta\_1 = 0β1​=0 (no relationship; the slope is zero)
* Alternative hypothesis H1H\_1H1​: β1≠0\beta\_1 \neq 0β1​=0 (there is a relationship; the slope is not zero)

**Step 2: Check the test statistic and p-value**

* t-statistic = 9.65 (from output)
* p-value (Sig.) = 0.000

**Step 3: Decision Rule**

* If p-value < 0.05 (common alpha level), reject the null hypothesis.

**Step 4: Conclusion**

* Since the p-value is 0.000 < 0.05, we reject H0H\_0H0​.
* There is **a statistically significant relationship** between hours of study and exam scores.

**d) How much variance in exam scores is explained by hours of study?**

From the SPSS output:

* R2=0.692R^2 = 0.692R2=0.692

**Interpretation:**

* R Square (coefficient of determination) tells us the proportion of variance in the dependent variable (exam scores) that is explained by the independent variable (hours of study).
* **69.2%** of the variance in exam scores is explained by hours of study.
* The remaining **30.8%** of the variance is due to other factors not included in the model.

**Note:** You mentioned "Adjusted R-Square" in your answer, but only regular R Square (0.692) is provided here. Adjusted R Square accounts for the number of predictors, but since this is a simple linear regression with one predictor, R Square and Adjusted R Square will be very close.

**Question 2: Chi-Square Test of Independence**

**Context:**

We want to determine if there's an association between **gender** and **preferred learning style**.

**a) State the null and alternative hypotheses for the Chi-Square test.**

**Null hypothesis H0H\_0H0​:**

* Gender and learning style preference are **independent** (no association).

**Alternative hypothesis H1H\_1H1​:**

* Gender and learning style preference are **not independent** (there is an association).

**b) What is the value of the chi-square statistic and the degrees of freedom?**

From the SPSS output:

* Chi-square statistic = **9.417**
* Degrees of freedom (df) = **2**
* p-value = **0.009**

**Explanation:**

* The **chi-square statistic (9.417)** measures the difference between the **observed frequencies** and the **expected frequencies** (what we’d expect if gender and learning style were truly independent).
* The **degrees of freedom** for a Chi-Square Test of Independence is calculated as:

df=(r−1)(c−1)df = (r - 1)(c - 1)df=(r−1)(c−1)

Where:

* rrr = number of rows (genders = 2)
* ccc = number of columns (learning styles = 3)

So:

df=(2−1)(3−1)=1×2=2df = (2 - 1)(3 - 1) = 1 \times 2 = 2df=(2−1)(3−1)=1×2=2

**Conclusion (based on Chi-Square test):**

* Since **p = 0.009 < 0.05**, we **reject the null hypothesis**.
* This means there **is a statistically significant association** between gender and preferred learning style.

**Summary of Key Concepts:**

| **Test** | **Purpose** | **Statistical Output** | **Interpretation** |
| --- | --- | --- | --- |
| Regression | Predicts one variable from another | R, R², coefficients, p-value | Strong positive relationship; 69.2% of variance explained |
| Chi-Square | Tests association between 2 categorical variables | Chi-square value, df, p-value | Gender and learning style are significantly associated |