قسم الإحصاء

أسئلة امتحان الكورس الاول
الدراسات العليا
الماجستير

للعام الدراسي 2025 - 2026

University of Basra
Collage of Management And
Economic
Program: M. Sc. In statistics

Subject : Statistical Inference
Time: 3   hrs.
Date: 4/ V 2025
Exam: First semester exam
Academic Year: 2025/2026

*Remark : Answer Five questions only

Q1/ A-Show that the m.l.e for θ in the following distribution

$$f(x,\theta) = \frac{1}{\alpha!\ \theta^{\alpha+1}}\ x^{\alpha}\ e^{-\frac{x}{\theta}}\ ; x > 0;\ \theta > 0$$

And α is known , $\hat{\theta} = \frac{\sum_{i=1}^{n} x_i}{\alpha+1}$

B- Let $X_1, X_2, \ldots, X_n$ be i.i.d. uniform over (θ_1, θ_2). Find the Moment Estimator for θ_1 , θ_2 .

(14 marks)

Q2/ the number of days of service provided by n=7 watch batteries of brand A were 307,355, 324, 384, 434, 362, 274. Whereas the number of days for service provided by m=9 watch batteries of brand B were 295, 336, 422, 329, 389, 374, 473, 326, 386 use these data to compute 95% confidence limits for the difference in the two expected life.

(14 marks)

Q3/A- let X have a p.d.f. of the form $f(x,\theta) = \frac{1}{\theta}$; $0 < x < \theta$, let $Y_1 < Y_2 < Y_3 < Y_4$ denote the order statistics of a r.s. of size 4 from this distribution. We reject $H_0: \theta = 1$ and accept $H_1: \theta \neq 1$ if $y4 \leq \frac{1}{2}$. Find the power function $K(\theta)$.

B- Let X posses a poison distribution with mean θ , suppose we want to null hypothesis $H_0: \theta = \theta_0$ against the alternative hypothsis $H_1: \theta = \theta_1$ where $\theta_1 < \theta_0$. Find the Best critical region for this test.

(14 marks)

Q4/ For a r.s. of size n from a geometric distribution

$$P(x,\theta) = \theta(1-\theta)^x\ I_{(0,1,\ldots)}(x),\ 0 < \theta < 1$$

What is the smallest possible variance for an unbiased estimator of $(1-\theta)$?

(14 marks)

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Q5/ Let $Y_1, Y_2, \ldots, Y_5$ is an order statistic of a r.s. taken from a distribution with $f(x, \theta) = \frac{1}{\theta}$; $0 < x < \theta$. is Y_5 a consistent estimator for θ.

(14 marks)

Q6/ A- Show that

$$nE[\frac{\partial \ln f(x, \theta)}{\partial \theta}]^2 = -n E[\frac{\partial^2 \ln f(x, \theta)}{\partial \theta^2}]$$

B- Define $P(Type \prod error)$, Operating characteristic function, Fisher information.

(14 marks)

GOODLUCK.

Ass. prof. Dr. Bahaa Abdul Razak Qasim
Lecturer

Ass. Prof. Dr. Ali N. Hussein
Head of Dept.

University of Basra		Subject :
Collage of Management And		Time: 3 hrs.
Economic		Date: / / 2025
		Exam: Second semester exam
Program: M. Sc. In statistics		Academic Year: 2024/2025

*Remark : Answer 4 questions only

Q1 : A random sample consisting of five observations is given, in which both the dependent variable and the independent variable take the following values:

Yi=1, 2, 3, 1, 0
Xi=2, 5, 4, 3, 1

It is known that the error term satisfies Ut~N(0,$\sigma^2 \Omega$), and that Ut follows a first-order autocorrelation process with an estimated value of $\hat{\rho}$=-0.7

Required:

1. Estimate the parameters of the model.
2. Estimate the variance–covariance matrix of the estimated parameters.

Q2 :
1. Explain the variance–covariance matrix of the ridge regression estimator.
2. Derive the mean squared error (MSE) of the ridge regression estimator.
3. Prove that $MSE(\beta_{RR})< MSE(\beta_{LS})$

Q3 : Consider the following linear model: $Y_t=BX_t+u_t$ t=1,2,3,...,n

$E(u_t)=0$,$Var(u_t)=\sigma_u^2 [.E(Y_t)]^2 = 0$

Prove that the weighted least squares (WLS) estimator of B is equal to:$\hat{B} = \frac{1}{n}\sum_{t=1}^{n}\frac{Y_t}{X_t}$

Q4: To study the linear relationship between the dependent variable Yt and the independent variable Xt, a random sample of 4 observations was taken. Suppose that Yt=BtXt+uT   measured in deviations, Ut follows a first-order autocorrelation process. Ut= ρU_{t-1}+et

et~N(0, σ^2) , E(et et')=0

Under the above conditions, prove that the efficiency of the slope estimator relative to B1 IN GLS relative to OLS equal to

$$eff(b1)=\frac{1}{1+2\rho^2+2\rho^4+2\rho^6}$$

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Q5: You are given the following structural model : $Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + U_t$

where the variable X_{1t} is **endogenous**, while X_{2t} is an **exogenous** variable.

You are given the following set of instruments: Z_1, Z_2, Z_3

1. Determine the number of endogenous variables and the number of instruments in each of the following cases:

   - Using Z_1 only
   - Using Z_1, Z_2
   - Using Z_1, Z_2, Z_3

2. Classify the model in each case as:

   - **Under-identified**
   - **Exactly identified**
   - **Over-identified**

In the case of over-identification:

- Can the Two-Stage Least Squares (2SLS) method be used?
- State the appropriate test for checking the validity of the instruments.
- Write the null hypothesis and the alternative hypothesis for the test used in the case of over-identification.

GOOD LUCK

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Ass. prof Dr. Ali N. Hussein
Head of Dept.

University of Basra
Collage of Management And Economic
Program: M. Sc. In statistics

Subject: Linear Model
Time: 3 hrs.
Date: / / 2025
Exam: First semester exam
Academic Year: 2025/2026

*Remark : Answer only five questions, for each question (14) degrees

Q1\\ (A): Correct the following statements.

1. Let A be n x n with eigenvalues , when A is positive definite, then $\lambda_i < 0$.

2. distribution of u away for approaches normality very slowly as n increases.

3. PRESS may be an equivalent measure SSE of how well the model will predict future observations.

4. Let A be a pxp positive definite matrix and let B be a k x p matrix of rank k = p. Then BAB' is positive semidefinite .

5. When H_0 is false, the noncentrality parameter is a function of X, which is random. In this case, the noncentral F distribution is applied.

(B): Let tow independent random variables u_1 and u_2 be distributed as $\chi^2_{(n_1,\lambda_1)}$ and $\chi^2_{(n_2,\lambda_2)}$ espectively. The random variable $u=u_1+u_2$ is distributed as $\chi^2_{(n,\lambda)}$ where $n=n_1+n_2$, $\lambda=\lambda_1+\lambda_2$, $E(u_1)=n_1+2\lambda_1$, $var(u_1)= 2n_1+8\lambda_1$, $E(u_2)= n_2+\lambda_2$, $var(u_2)= 2n_2+8\lambda_2$. Find E(u) and var(u)?

Q2\\ (A): Choose the correct answer to fill in the following blanks.

1. A is called the alias matrix if ....

  a. $A = (X_1'X_2)^{-1} X_1' X_2$ b. $A = (X_1'X_1)^{-1} X_1' X_1$ c. $A = (X_1'X_1)^{-1} X_1' X_2$

2. If $\beta_1 \neq 0$, then .... since $X_c'X_c$ is positive definite, and we expect F to Exceed 1.

  a. $E(SSR/k) < \sigma^2$ b. $E(SSR/k) > \sigma^2$ c. $E(SSR/k) = \sigma^2$

3. If $\rho^2_{Y\cdot X} = 0$, the expected value of R^2 is given by..........

  a. $E(R^2)=1-\dfrac{|R|}{|R_{xx}|}$ b. $E(R^2)=\dfrac{k}{n-1}$ c. $E(R^2)=1-\dfrac{1}{r^{yy}}$

4. If y is $p\times 1$, x is $q\times 1$, and Σ_{xy} is $p\times q$. Let A be a $q\times p$ matrix of constants. Then ....

  a. $E(x'Ay)\ tr(A\Sigma_{yx}) + \mu_x'A\mu_y$ b. $E(x'Ay)\ tr(\mu_x A\mu_y) + A'\Sigma A$ c. $E(x'Ay) = \mu_x A\mu_x + tr(A'\Sigma A)$

5. If y is $N_n(X\beta, \sigma^{2}I)$, then $SSR/\sigma^2\ \hat{\beta}_1'X_c'X_c\hat{\beta}_1 \sigma^2$ So the SSR/σ^2 has a distribution is............

  a. $\chi^2(n-k-1)$ b. $\chi^2(k, n-k-1, \lambda_1)$ c. $\chi^2(k, \lambda_1)$

(B): Suppose that Y is $N(\mu, \Sigma)$ where $\mu = \begin{pmatrix} 7 \\ 0 \\ 4 \end{pmatrix}$, $\Sigma = \begin{pmatrix} 1 & 2 & 0 \\ 2 & 3 & -2 \\ 0 & -2 & 5 \end{pmatrix}$, $U_1 = Y_1 - 7Y_2 + 2Y_3$, $U_1 = -5Y_2 + 3Y_3$.

find the distribution U ?

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Q3: Choose the correct answer with clarification when choosing.

1. The deleted residual $\hat{\varepsilon}_{(i)} = y_i - x_i \hat{\beta}_{(i)}$ can be expressed in terms of $\hat{\varepsilon}_i$ and h_{ii} as $\hat{\varepsilon}_{(i)}$ equals

a. $h_{ii} - \dfrac{\hat{\varepsilon}_i}{h_{ii} - 1}$
b. $h_{ii} - \dfrac{\hat{\varepsilon}_i}{1 - h_{ii}}$
c. $= h_{ii} + \dfrac{\hat{\varepsilon}_i}{1 - h_{ii}}$
d. Not from the above

2. If $u = (y, x_1, x_2, \cdots, x_k)$, $\mu = \begin{pmatrix} 4 \\ 6 \end{pmatrix}$, $\Sigma = \begin{pmatrix} 12 & 4 \\ 4 & 20 \end{pmatrix}$ then

a. $\text{var}(y/x) \geq \text{var}(y)$
b. $\text{var}(y/x) \leq \text{var}(y)$
c. $\text{var}(y/x) \approx \text{var}(y)$
d. Not from the above

3. IF $\hat{\beta}_z = (W'W)^{-1} W'Y$, $W = XH$ then

a. $R_{II}^2 = R_X^2$
b. $R_{II}^2 \langle R_X^2$
c. $R_{II}^2 \rangle R_X^2$
d. Not from the above

4. Let $u = X'AX$, where A is a symmetric matrix of constants. Then

a. $\dfrac{\partial u}{\partial X} = 2X'AX$
b. $\dfrac{\partial u}{\partial X} = 2XAX$
c. $\dfrac{\partial u}{\partial X} = 2AX1$
d. Not from the above

Q4\\ Find and prove the mean and variance for MSR?

Q5 The sample covariance matrix of the residual vector $y_i - \hat{y}_i(x)$ is equivalent to $S_{y - \hat{y}}$ and
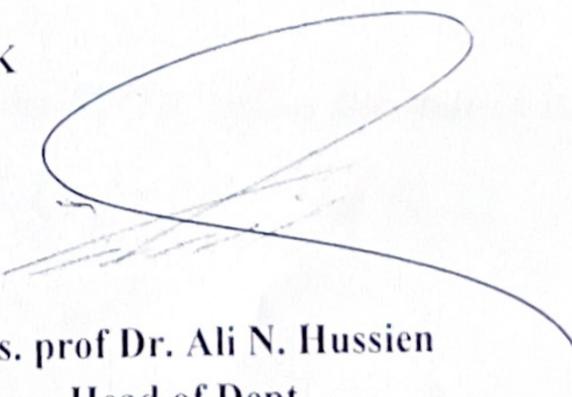
$S = \begin{pmatrix} S_{yy} & S_{yx} \\ S_{xy} & S_{xx} \end{pmatrix}$, $S_{yy} = \sum_i (y_i - \bar{y})(y_i - \bar{y})' / n - 1$, $S_{yx} = \sum_i (y_i - \bar{y})(x_i - \bar{x})' / n - 1$,

$S_{xx} = \sum_i (x_i - \bar{x})(x_i - \bar{x})' / n - 1$, Find $S_{y - \hat{y}}$

Q6 If y is $N_n(X\beta, \sigma^2 I)$, then the F test for $H_0 : C\beta = 0$ is equivalent to the likelihood ratio test. Prove that?

GOOD LUCK

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University of Basra
Collage of Management And Economic
Program: M. Sc. In statistics

Subject : Program
Time: 3 hrs.
Date: 24/ 12/ 2025
Exam: First semester exam
Academic Year: 2025/2026

*Remark : Answer 5 questions only

Q1/ If $y = X - \frac{X^3}{4!} + \frac{X^5}{6!} - \frac{X^7}{8!} + \frac{X^9}{10!} - \frac{X^{11}}{12!}$ Write a program to compute Y and then find $\bar{X}$ and $\bar{Y}$ to 20 Values of X. (14 marks)   (14 marks)

Q2/ Write a program to compute Z where:

$$Z = \begin{cases} a + b + C & \text{if} \quad a < b \text{ and } b < c \\ \sqrt{\dfrac{a^2+b^2+c^2}{abc}} & \text{if} \quad b > a \text{ and } b > c \\ \log(a + b + c) & \text{if} \quad o.w \end{cases}$$

Q3/ Let you have 50 values of Xi , Yi , i=1,2,3,...,50 Write a program to compute r where :   (14 marks)

$$r = \frac{\sum X_i Y_i - \sum X_i \sum Y_i / n}{[\sum X_i^2 - \sum \frac{X_i}{n}][\sum Y_i^2 - \sum \frac{Y_i}{n}]}$$

Q4/ If $R \sim EXP(0.2)$ and $ui \sim N(0,1)$ and let $Xi = 3(1 - \log(R))^{0.5}$ then :
Write a program to compute Yi where : $Yi = \log(Xi) + ui$ and compute $\bar{X}$ and $\bar{Y}$. (14 marks)

Q5/ Write a program to estimate simple linear regression parameters according to the least squares method if you know that: (14 marks)

$$\widehat{B1} = \frac{\sum_{i=1}^{n} XiYi - \frac{\sum Xi \sum Yi}{n}}{\sum_{i=1}^{n} Xi^2 - \frac{(\sum Xi)^2}{n}} \quad , \quad \widehat{B0} = \bar{Y} - \widehat{B1}\bar{X} \quad , i = 1,2,3,...,40$$

Q6/ Write a main program to calculate the values of Y where $Y_i = 5 + X_i$ using a subprogram to calculate the values of X_i where $Xi \sim EXP(3)$ (14 marks)

GOOD LUCK

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University of Basra
Collage of Management And
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Program: M. Sc. In statistics

Subject : Nonparametric statistics
Time: 3 hrs.
Date: 7 / 2025
Exam: Second semester exam
Academic Year: 2025/2026

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*Remark : Answer five questions only, for each question(14 marks).

Q1) A- Find the median confidence interval. If the differences between each sample pair is flows, Differences: 0 -4 +9 -7 +4 +15 -4 +1

B- Fill in the following blanks:

1- The Kolmokorov-Smirnov two-sample test tests the -------------- of both samples.
2- In the Kruskall Waills H-test use a table with the ----------- to obtain a critical value when performing a large sample.
3- The Mann-Whitney U test statistic represents the ------------ of the calculated values of U1 and U2.

Q2) Instead of appoint estimate of empirical density function $F(X) = pr(X \leq x)$ once might be interested in a point estimator of $F(y)$. $F(x)=pr[x < x \leq y]$ for fixed $(x<y)$ show that: $var[Fn(y) - Fn(x)] = \frac{1}{n}[F(y) - F(x)][1 - F(y) + F(x)]$

Q3) A- What is the relationship between the standard deviation and Z-score, and give example for explain.

B- For the data in the table below Determine the effect size for the association between level of education and job satisfaction.

	Teacher education level (observed)			
	Bachelor's degree	Master's degree	Post-Master's degree	Row tota
Satisfied	60	41	19	120
Unsatisfied	10	13	15	38
Column totals	70	54	34	158

Q4) For the Nonparametric regression illustrates the following :

1- Explain the reasons for using non-parametric regression.
2- What is the kernel smoothing regression method
3- What are the basic conditions for kernel regression.
4- What are the types of kernel density.

Q5) A- How to perform this tests using spss.

1- Kolmogorov-Smirnov two sample test.
2- Spearman rank-order correlation.

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B- Calculate the correlation between the two variables in the table below. Were the Exam performance is a continuous dichotomous variable and GPA is an interval scale variable.

participant	1	2	3	4	5	6	7	8	9	10	11
Exam performance	F	F	F	F	F	P	P	P	P	P	P
GPA	3.5	3.4	3.3	3.2	3.6	4.0	3.6	4.0	4.0	3.8	3.9

Q6) The table below represent the rank values of times from each employee was late in given month. The baseline shows the employees' monthly tardiness before any of the strategies in either example. Month 1 shows the employees' monthly tardiness after a month of the 10$ bonuses. Month 2 shows the employees' monthly tardiness after a month of the 20$ bonuses. We want to determine if either of the strategies reduced employee tardiness

	Ranks of monthly tardiness		
Employee	Baseline	Month 1	Month 2
1	2	3	1
2	3	2	1
3	2	3	1
4	3	2	1
5	3	1.5	1.5
6	2.5	2.5	1
7	3	2	1

Table values: r(11,0.05)=0.553; r(9,0.05)=0.602; T(7,0.05) = 2; T(8,0.05) = 3; $x^2(2,0.05) = 5.99$; Fr(7,3,0.05)=7.14; U(7,7,0.05)=8.

GOOD LUCK

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Basrah University
College of Administration and Economics
Department of Statistics
M.Sc in statistics
English language , First Attempt

Note: Answer ALL questions. Follow the specific requirements stated for each question regarding the number of items to answer.

Q1/ Read the following passage carefully, then answer any FIVE of the questions below (15 Marks):

Why AI matters in economics, nowcasting, supply chains, recommender systems, fraud

Artificial Intelligence (AI) has moved from a promising toolkit to a core research and practice infrastructure across Economics, Commerce, and Administration. Empirical work now shows that modern AI—encompassing machine-learning (ML), deep learning, and large language models (LLMs)—can process high-dimensional, heterogeneous data; generate more accurate and timely predictions; automate routine cognitive work; and support evidence-based decision-making at scale. Taken together, these capabilities enhance productivity and innovation in both academic research and real-world institutions. At the same time, leading international bodies underscore ethical, distributional, and skills-transition challenges that require deliberate governance.

A large literature now documents how ML extends classic econometrics to settings with many predictors, nonlinearities, and unstructured data (text, images, audio). In a widely cited synthesis, Mullainathan & Spiess (2017) explain how ML improves prediction and complements inference when researchers face complex feature spaces that traditional models handle poorly. This predictive lift is not merely technical: it underwrites downstream tasks—from policy targeting to early-warning systems—where forecast accuracy is decisive. These gains show up in concrete macro-financial problems. Work on nowcasting and forecasting combines traditional indicators with digital traces such as Google Trends, improving real-time measurement of GDP, retail sales, and labor-market activity. Likewise, ML methods have been deployed for inflation and unemployment forecasting and to build early-warning systems for financial crises—often outperforming single-model baselines, in part by fusing heterogeneous data and allowing flexible functional forms. Implication. For economics, AI enables: (i) higher-frequency "nowcasts" of key aggregates; (ii) more adaptive structural/semistructural models that handle regime changes and richer covariates (e.g., consumer behavior, geopolitical shocks); and (iii) text-as-data pipelines (central-bank communications, earnings calls, news) that sharpen measurement of expectations and risk.

In commerce, AI capabilities map naturally to the firm's value chain. Supply chains. Systematic reviews and recent studies show ML and deep learning improving demand forecasting, inventory control, supplier selection, routing, and disruption management—areas where nonlinearity, covariate shift, and rare-event risks degrade

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English language , First Attempt

classical tools. Pandemic-era work on supply-chain risk underscores how ML mitigates shocks by surfacing early anomalies and optimizing recovery. Market intelligence and personalization. Recommender-system research (distilled in ACM and related venues) documents substantial gains from modern representation learning for customer segmentation, ranking, and cross-sell/upsell—thereby lifting conversion and improving customer experience through personalization at scale. Financial integrity and fraud. Financial platforms increasingly use ML (including deep and hybrid approaches) to detect anomalous transactions under extreme class imbalance, where false negatives are costly and patterns drift over time. Recent surveys and studies detail robust pipelines that combine supervised/unsupervised models and explainability tools for operational use. Implication. For commerce, AI's edge is twofold: automating complex, data-rich operational choices (supply, pricing, routing) and continuously learning fine-grained customer preferences to personalize experiences while protecting platforms against fraud.

1. How do recommender systems contribute to firm performance according to the essay?	2. Which statement best captures why AI matters for modern economic research?
3. In financial integrity, why are ML methods emphasized for fraud detection?	4. How does text-as-data improve economic measurement and policy analysis?
5. In commerce, what is a central benefit of AI for supply chains?	6. What is a key implication of AI-enabled nowcasting for macroeconomic management?

Q2/ Fill in the blanks with appropriate words from the passages in your textbook. Choose the word that best fits the context and maintains the correct meaning of each sentence (10 Marks):

Air pollution is a major problem all over the world today. Probably the single biggest (1) _____ to the problem is the motor vehicle. However, there are many other man-made sources, such as (2) _____ factories, power (3) _____, (4) _____, building, and the (5) _____ of fossil fuels and wood in homes around the world. There are natural sources of air pollution too; (6) _____ and (7) _____ fires produce a lot of (8) _____. However, it is the increasing number and use of motor vehicles that is doing the most damage, and (9) _____, where there are more cars, there is more pollution, that is, in the major cities of the world. Some of the most polluted cities include Beijing, Mexico City, Athens, Moscow, and Mumbai. This problem of increased pollution in the major cities of the world has led to an increase in the number of studies done to look at the effects on our health. The results so far are not very (10) _____.

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English language , First Attempt

Q3/ Select the correct verb form for each of the following sentences. Answer any FIVE questions (10 Marks):

I. At this time next week, the consultants _____ the feasibility study with stakeholders. (DISCUSS: Future Continuous)

A) discuss	B) will discuss
C) will be discussing	D) will have discussed

II. Last month, the board _____ the merger proposal after extensive deliberation. (REJECT: Simple Past)

A) rejects	B) rejected
C) was rejecting	D) had rejected

III. The IT department _____ the network infrastructure regularly to prevent downtime. (MAINTAIN: Simple Present)

A) maintained	B) maintains
C) is maintaining	D) has maintained

IV. Since last quarter, the research team _____ innovative solutions to reduce production costs. (EXPLORE: Present Perfect Continuous)

A) explores	B) explored
C) has explored	D) has been exploring

V. By the time the new policy was announced, employees _____ concerns for several weeks. (RAISE: Past Perfect Continuous)

A) raised	B) were raising
C) had been raising	D) have been raising

VI. Starting next year, the company _____ its carbon footprint by implementing green technologies. (REDUCE: Simple Future)

A) will reduce	B) reduces
C) will be reducing	D) will have reduced

Q4: Select the most appropriate word from the table below to fill each blank in the passage. Use each word only once (10 Marks)

Unfortunately	Spyware	Up-to-date	Control
Junk	Promising	Organizations	Passwords
Commercial	Designed	Unwanted	Phishing

Once it has this information, it is sent to **(a)** _____ that steal your money from your bank or use your credit card to buy things. Another danger is **(b)** _____. Like the Trojan Horse, it hides inside your computer so that you don't know it is there. It might not do any damage, but it collects information about you, for example, what you buy online or what music you download. It then sends this to **(c)** _____ companies. A more common, but less dangerous, problem is 'spam', or **(d)** _____ advertising. When it first appeared,

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nobody worried about it, but now it is out of **(e)** _____ : more than 50% of all email messages in the world are **(f)** _____ mail, or spam. **(g)** _____ , some people are now using spam to trick people and to get money from them. This is called 'phishing'. The simplest **(h)** _____ trick is to send an email **(i)** _____ that you will get rich. However, to get this money, you must first send your bank details. Of course, they take the money from your bank and you certainly don't get rich! Therefore, next time you're online, make sure your anti-virus program is **(j)** _____ and never give anyone your bank details.

Q5/ Complete the following sentences by writing the correct form of the verb in brackets according to the tense indicated. Answer any FIVE questions (10 Marks)

i.	Yesterday, our team _____ the quarterly sales figures before the board meeting. (ANALYZE: Simple Past)	ii.	By 2019, the fund _____ in several green-energy startups before the market surged. (INVEST: Past Perfect)	iii.	Our finance committee _____ large expenditures within two business days. (APPROVE: Simple Present)
iv.	The finance office _____ operating costs by 12% this year. (REDUCE: Present Perfect)	v.	Throughout Q2, the company _____ decision-making to regional clusters. (DECENTRALIZE: Future Continuous)	vi.	By next quarter, all departments _____ their KPIs with the corporate strategy. (ALIGN: Future Perfect)

Q6/ Write an essay of at least 150 words on ONE of the following topics (15 Marks):

A. How to Use Artificial Intelligence to Improve Your Academic Research Writing	B. The Role of Financial Literacy in Personal and Small Business Financial Planning

Examiner

Dr. Ayad Mohmmad

Head of Dep.

Dr. Ali Naseir