Modelling and System Identification – Microexam 1

Prof. Dr. Moritz Diehl, IMTEK, Universität Freiburg, and OPTEC/ESAT-STADIUS, KU Leuven

December 4, 2013, 16:00-17:00, Freiburg

Nachname:	Vorname:	Matrikelnummer:	
Fach:	Studiengang: Bachelo	r Master Lehramt Sons	stiges
Please fill in your name above and t	ick exactly one box for the rig	th answer of each question belo	w.
1. What is the probability densit σ^2 ? The answer is $f_e(x) = \frac{1}{\sqrt{2}}$		normally distributed random var	riable e with mean μ and varian
(a) $e^{-\frac{(x-\mu)^2}{2\sigma}}$	(b) x $e^{-\frac{(x-\mu)^2}{2\sigma^2}}$	(c) $e^{\frac{(x-\mu)^2}{2\sigma}}$	(d) $e^{\frac{(x-\mu)^2}{2\sigma^2}}$
2. What is the PDF of a variable	z with uniform distribution o	n the interval $[a, b]$? For $x \in [a, b]$	b] it has the value:
(a) $f_z(x) = (a-b)^2$	(b) $f_z(x) = (b-a)$	(c) \mathbf{X} $f_z(x) = \frac{1}{b-a}$	(d) $f_z(x) = \frac{x}{\sqrt{b-a}}$
3. What is the PDF of an <i>n</i> -dim answer is $f_z(x) = \frac{1}{\sqrt{(2\pi)^n \det}}$		d variable z with zero mean and	l covariance matrix $P \succ 0$? T
(a) $e^{\frac{1}{2}x^TP^{-1}x}$	(b) $e^{-\frac{1}{2}x^T P x}$	(c) $e^{\frac{1}{2}x^T P x}$	(d) $\mathbf{X} e^{-\frac{1}{2}x^T P^{-1}x}$
 Regard a random variable x e regard another random variab 	$\in \mathbb{R}^n$ with mean $c \in \mathbb{R}^n$ and c ble y defined by $y = b + Ax$.		or a fixed $b \in \mathbb{R}^m$ and $A \in \mathbb{R}^{m \times n}$
(a) $b^T A c + c^T P c$	(b) $y - b + Ax$	(c) \mathbf{x} $b + Ac$	(d) $Axx^T A^T$
5. Above in Question 4, what is	the covariance matrix of y ?		
(a) $AP^{-1}A^T$	(b) \mathbf{x} APA^T	(c) $A^T P^{-1} A$	(d) $c^T P c$
6. (*) Above in Question 4, what	at is the mean of the matrix val	lued random variable $Z = yy^T$?	
(a) $(b+Ac)(b+Ac)^T$	<u> </u>	(b) $bb^T + Acc^T A^T$	
$(c) \mathbf{x} (b + Ac)(b + Ac)^T$	$T + APA^T$	(d) $bb^T + Acc^T A^T + Acc^T A A + Acc^T A + A$	APA^T
7. A scalar random variable has	the standard deviation a . What	at is its variance?	11
(a) a^{-1}	(b) \sqrt{a}	(c) a	(d) \mathbf{x} a^2
8. A scalar random variable has		ndard deviation?	
(a) v^{-1}	(b) $\mathbf{x} \sqrt{v}$	(c) v	(d) v^2
9. Regard a random variable α	$\in \mathbb{R}$ with zero mean and varian	nce σ^2 . What is the mean of the	random variable $z = \alpha^2$?
(a) $\alpha + \sigma$	(b) $\alpha + \sigma^2$	(c) σ	(d) $\mathbf{x} \sigma^2$
10. (*) Regard a random variable	$x \in \mathbb{R}^n$ with zero mean and c	covariance matrix P. What is the	e mean of $z = x^T x$?
(a) \mathbf{x} trace(P)	(b) det (P)	(c) $ P _2^2$	$\ (\mathbf{d}) \square \ P \ _F^2$
11. What is the minimizer x^* of t	the convex function $f: \mathbb{R} \to \mathbb{I}$	$\mathbb{R}, f(x) = e^x - \overline{x ?}$	
(a) $x^* = -1$	(b) $x x^* = 0$	(c) $x^* = 1$	(d) $x^* = \log_e(2)$

points on page: 11

12.	What is the minimizer x^* of the	the convex function $f: \mathbb{R} \to \mathbb{R}$,	$\label{eq:f(x) = a + \beta x + \gamma x^2} with$	$\gamma > 0$?
	(a) $x^* = \frac{2\beta}{\alpha}$	(b) $x^* = -\frac{\beta}{\gamma}$	(c) \mathbf{X} $x^* = -\frac{\beta}{2\gamma}$	(d) $\qquad x^* = -\frac{\beta}{\alpha}$
13.	What is the minimizer of the c	onvex function $f: \mathbb{R}^n \to \mathbb{R}, [j]$	$f(x) = y - \Psi x _2^2$ (with Ψ of	rank n)? The answer is $x^* = \dots$
	(a) $-(\Psi^T \Psi)^{-1} \Psi^T y$	(b) x $(\Psi^T \Psi)^{-1} \Psi^T y$	(c) $-(\Psi\Psi^T)^{-1}\Psi^T y$	(d) $(\Psi \Psi^T)^{-1} \Psi^T y$
14.	What is the minimizer of the f	unction $f : \mathbb{R}^n \to \mathbb{R}, f(x) =$	$\ b + A^T x\ _2^2$ (with A^T of rank	$(x n)$? The answer is $x^* = \dots$
	(a) $-(A^T A)^{-1} A^T b$	(b) $(A^T A)^{-1} A^T b$	(c) $\mathbf{x} - (AA^T)^{-1}Ab$	(d) $(AA^T)^{-1}A^Tb$
15.	For a matrix $\Psi \in \mathbb{R}^{N \times d}$ with a	cank d (and $N \ge d$), what is its	pseudo-inverse Ψ^+ ?	
	(a) $(\Psi^T \Psi)^{-1} \Psi$	(b) $(\Psi \Psi^T)^{-1} \Psi$	(c) x $(\Psi^T \Psi)^{-1} \Psi^T$	(d) $(\Psi \Psi^T)^{-1} \Psi^T$
16.	Given a sequence of numbers	$y(1),\ldots,y(N)$, what is the mi	nimizer θ^* of the function $f(\theta)$	$\theta = \sum_{k=1}^{N} (y(k) - \theta)^2$?
	(a) $\frac{N}{\sum_{k=1}^{N} y(k)}$	(b) $\mathbf{x} = \frac{\sum_{k=1}^{N} y(k)}{N}$	(c) $\qquad \frac{1}{N} \sum_{k=1}^{N} y(k)^2$	(d) $1 \frac{1}{N^2} \sum_{k=1}^N y(k)^2$
17.	What does "i.i.d." stand for?			
	(a) infinite identically d	listurbed	(b) infinite identically of	lependent
	(c) x independent identic	ally distributed	(d) independent identic	ally disturbed
18.	Given a sequence of i.i.d. scal	ar random variables $x(1), \ldots,$	$x(N)$, each with mean μ and	variance σ^2 , what is the expected
	value of their arithmetic mean,	, i.e. of the random variable y_N	defined by $y_N = \frac{1}{N} \sum_{k=1}^N x_k$	(k) ?
	(a) $\mathbf{x} \mu$	(b) $\frac{\mu}{\sqrt{\sigma^2}}$	(c) $\frac{\mu}{\sigma^2}$	(d) μ
19.	In Question 18, what is the var	riance of the variable y_N ?		
	(a) $\mathbf{X} = \frac{\sigma^2}{N}$	(b) $\qquad \frac{\sigma}{N}$	(c) $\frac{\sigma^2}{N^2}$	(d) $\frac{\sigma}{N-1}$
20.	Given a prediction model $y(h)$	$k = \theta_1 + \theta_2 e^{x(k)} + \epsilon(k)$ with	h unknown parameter vector θ	$= (\theta_1, \theta_2)^T$, and assuming i.i.d.
	noise $\epsilon(k)$ with zero mean, and	given a sequence of N scalar in	nput and output measurements a	$x(1),\ldots,x(N)$ and $y(1),\ldots,y(N),$
	we want to compute the lines $y_N = (y(1), \dots, y(N))^T$, how			ction $f(\theta) = y_N - \Psi_N \theta _2^2$. If
	$\begin{bmatrix} g_N &= (g(1), \dots, g(1)) \end{bmatrix}$	$\begin{bmatrix} 1 & -r(1) \end{bmatrix}$	$\begin{bmatrix} r_N \in \mathbb{R} \\ r_N \in \mathbb{R} \end{bmatrix}$	$\begin{bmatrix} 1 & e^{x(1)} \end{bmatrix}$
		(b) : :		
	$\begin{bmatrix} \cdot & \cdot \\ 1 & x(N) \end{bmatrix}$	$\begin{bmatrix} \cdot & \cdot \\ 1 & -x(N) \end{bmatrix}$	$\begin{bmatrix} \cdot & \cdot \\ e^{x(1)} & 1 \end{bmatrix}$	$\begin{bmatrix} \cdot & \cdot \\ 1 & e^{x(N)} \end{bmatrix}$
21.	Given an autoregressive affine	e dynamic system model $y(k)$	$= \theta_1 + \theta_2 y(k-1) + \theta_3 y(k-1)$	$-2) + \epsilon(k)$ with i.i.d. noise $\epsilon(k)$
	with zero mean and unknow	n parameter vector $\theta = (\theta_1)$	$(\theta_2, \theta_3)^T$, and given a seque	ence of N output measurements
	$y(1), \dots, y(N)$, we want to c $ y_N - \Psi_N \theta _2^2$. If $y_N = (y(3))$	ompute the estimate $\hat{\theta}_N$ by m ,, $y(N)$ ^T , how do we need	inimizing the prediction error 1 to choose the matrix Ψ_N ?	function $f(\theta) = \sum_{k=3}^{N} \epsilon(k)^2 =$
	$\begin{array}{c c} & 1 & y(1) \end{array}$, , , , , , , , , , , , , , , , , , , 	$1 \qquad y(2)$	y(1)
			(b) x : :	
	$\begin{bmatrix} 1 & y(N-2) \end{bmatrix}$		$\begin{array}{c c} (\mathbf{b}) \boxed{\mathbf{x}} & \vdots & \vdots \\ 1 & y(N-1) & y \\ \hline & & & \\ y(3) & -y(2) \end{array}$	(N-2)
	$\begin{bmatrix} y(3) & y(2) \\ \vdots & \vdots \end{bmatrix}$	y(1)	$ \begin{bmatrix} y(3) & -y(2) \\ \vdots & \vdots \end{bmatrix} $	-y(1)
	$ \begin{array}{c c} (c) \\ \vdots \\ y(N) \\ y(N-1) \end{array} $	u(N-2)	$\begin{array}{ c c c c c } (\mathbf{d}) \boxed{} & \vdots & \vdots \\ y(N) & -y(N-) \end{array}$	1) $-u(N-2)$
		ə (*** =/]		-/ 9(/]

points on page: 10

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hname:	Vorname:	Matrikelnummer	r:
1:	Studiengang: Bache	elor Master Lehramt S	Sonstiges
aa fill in your nama ahay	ve and tick exactly one box for the r	ight answer of each question b	alouz
-	y density function (PDF) $f_e(x)$ for		
σ^2 ? The answer is $f_e(a)$		a normany distributed random	variable e with mean μ and var
(a) $e^{-\frac{(x-\mu)^2}{2\sigma}}$	(b) $e^{\frac{(x-\mu)^2}{2\sigma^2}}$	(c) $e^{\frac{(x-\mu)^2}{2\sigma}}$	(d) $e^{\frac{(x-\mu)^2}{2\sigma^2}}$
. What is the PDF of a v	variable z with uniform distribution	on the interval $[a, b]$? For $x \in$	[a, b] it has the value:
(a) $f_z(x) = (a - a)$	(b) $f_z(x) = (b - a)$) (c) $f_z(x) = \frac{1}{b-a}$	(d) $f_z(x) = \frac{x}{\sqrt{b-a}}$
	n n-dimensional normally distribut	ted variable z with zero mean a	and covariance matrix $P \succ 0$
answer is $f_z(x) = \frac{1}{\sqrt{2}}$			
(a) $e^{\frac{1}{2}x^T P^{-1}x}$	(b) $e^{-\frac{1}{2}x^T P x}$	(c) $e^{\frac{1}{2}x^T P x}$	(d) (d) $e^{-\frac{1}{2}x^T P^{-1}x}$
. Regard a random varia	ble $x \in \mathbb{R}^n$ with mean $c \in \mathbb{R}^n$ and	covariance matrix $P \in \mathbb{R}^{n \times n}$.	For a fixed $b \in \mathbb{R}^m$ and $A \in \mathbb{R}$
regard another random	variable y defined by $y = b + Ax$.	What is the mean of y ?	
(a) $b^T A c + c^T A$	Pc (b) $y - b + Ax$	$(c) \sum b + Ac$	(d) $Axx^T A^T$
. Above in Question 4, v	what is the covariance matrix of y ?	•	
(a) $AP^{-1}A^T$	(b) \bigwedge APA^T	(c) $A^T P^{-1} A$	(d) $\Box c^T P c$
. (*) Above in Question	4, what is the mean of the matrix v	valued random variable $Z = yy$	$T_{?}$
(a) $(b+Ac)(b+Ac)$		(b) $bb^T + Acc^T A^T$	
(c) (b + Ac)(b +	$(+Ac)^T + APA^T$	$(\mathbf{d}) \square bb^T + Acc^T A^T$	$+APA^{T}$
A scalar random varia	ble has the standard deviation a. W	hat is its variance?	
(a) a^{-1}	(b) \sqrt{a}		(d) a^2
. A scalar random varia	ble has the variance v . What is its s	tandard deviation?	\
(a) v^{-1}	(b) $\checkmark \sqrt{v}$	(c) v	(d) v^2
. Regard a random varia	ble $\alpha \in \mathbb{R}$ with zero mean and vari	iance σ^2 . What is the mean of the	he random variable $z = \alpha^2$?
(a) $\alpha + \sigma$	(b) $\alpha + \sigma^2$	(c) σ	(d) σ^2
(*) Pagard a random I	rariable $x \in \mathbb{R}^n$ with zero mean and	l aquariance matrix <i>B</i> What is	
	$\begin{array}{c c} \text{(b)} & \det(P) \end{array}$		_
<u> </u>			$\ (\mathbf{d}) \ \ P \ _F^2$
	x^* of the convex function $f: \mathbb{R} \to \mathbb{R}$		
(a) $x^* = -1$	(b) $\mathbf{X} x^* = 0$	(c) $x^* = 1$	$(\mathbf{d}) \qquad x^* = \log_e(2)$
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. what	t is the minimizer x^* of t	he convex function $f: \mathbb{R} \to \mathbb{R}$,	, $f(x) = \alpha + \beta x + \gamma x^2$ with $\gamma > 0$?	Y.
(a)	$x^* = \frac{2\beta}{\alpha}$	(b) $x^* = -\frac{\beta}{\gamma}$	(c) $\mathbf{X} x^* = -\frac{\beta}{2\gamma}$ (d) $\mathbf{x}^* = -\frac{\beta}{\alpha}$	<u> </u>
3. What	is the minimizer of the	convex function $f : \mathbb{R}^n \to \mathbb{R}, [$	$f(x) = y - \Psi x _2^2$ (with Ψ of rank n)? The answer is $x^* =$	=
(a)	$-(\Psi^T\Psi)^{-1}\Psi^Ty$	(b) $\mathbf{X} (\Psi^T \Psi)^{-1} \Psi^T y$	$ (\mathbf{c}) \square - (\Psi \Psi^T)^{-1} \Psi^T y \qquad (\mathbf{d}) \square (\Psi \Psi^T)^{-1} \Psi^T y $	
What	is the minimizer of the	function $f : \mathbb{R}^n \to \mathbb{R}, f(x) =$	$\ b + A^{\forall} x\ _2^2$ (with A^T of rank n)? The answer is $x^* = \dots$	
(a)	$(A^T A)^{-1} A^T b$	(b) $(A^T A)^{-1} A^T b$	$ (c) \bigwedge (-(AA^T)^{-1}A^b b) (d) (AA^T)^{-1}A^T b $	
5. For a	matrix $\boldsymbol{\Psi} \in \mathbb{R}^{N \times d}$ with	rank d (and $N \ge d$), what is its	s pseudo-inverse Ψ^+ ?	
(a)	$(\Psi^T \Psi)^{-1} \Psi$	(b) $(\Psi \Psi^T)^{-1} \Psi$	(c) $(\Psi^T \Psi)^{-1} \Psi^T$ (d) $(\Psi \Psi^T)^{-1} \Psi^T$] [
5. Give	n a sequence of numbers	$y(1)$, $y(2^{*})$, what is the mi	inimizer θ^* of the function $f(\theta) = \sum_{k=1}^{N} y(k) - \theta^*$?	d-[
(a)	$\frac{N}{\sum_{k=1}^{N} y(k)}$	$ (b) \left[\sum_{k=1}^{N} \frac{\sum_{k=1}^{N} y(k)}{N} \right] $	(c) $\frac{1}{N} \sum_{k=1}^{N} y(k)^2$ (d) $\frac{1}{N^2} \sum_{k=1}^{N} y(k)^2$	J.
V. What	does "i.i.d." stand for?			_ Î dr
(a)	infinite identically	disturbed	(b) infinite identically dependent	[1
(c)	X independent idention	cally distributed	(d) independent identically disturbed	- ~
3. Give	n a sequence of i.i.d. sca	lar random variables $x(1), \ldots,$, $x(N)$, each with mean μ and variance σ^2 , what is the expe	
value	of their arithmetic mean	n, i.e. of the random variable y_N	defined by $y_{1} = \frac{1}{N} \sum_{k=1}^{N} (x(k))$?	Va
(a)	μ	(b) $\frac{\mu}{\sqrt{\sigma^2}}$		V VA
	$ \Delta^{\mu} $	$\sqrt{\sigma^2}$	$ (c) _ \frac{\mu}{\sigma^2} \qquad (d) _ \frac{\mu}{N} $	
	•	ariance of the variable y_N ?	- (x(h)) sint lineral	
	testion 18, what is the value $\frac{2}{3}$			
9. In Qu	testion 18, what is the value $\frac{\sigma^2}{N}$	ariance of the variable y_N ?	- exp(-x(h)) NOT LINGAR-	IN. IMEide
). In Qu (a)	testion 18, what is the value $\frac{\sigma^2}{N}$ in a prediction model $y(\epsilon(k))$ with zero mean, and	ariance of the variable y_N ? (b) $\boxed{\sigma_N}$ (k) $= \Theta_1 + (\epsilon^2) + \epsilon(k)$ with d given a sequence of N scalar in	$\begin{array}{c c} \hline \\ \hline $	In. In. In. In. In. In. In. In. In. In
 In Qu (a) Given noise we we	testion 18, what is the value $\mathbf{X} = \frac{\sigma^2}{N}$ in a prediction model $y(\epsilon(k))$ with zero mean, and vant to compute the line	ariance of the variable y_N ? (b) $\boxed{\sigma_N}$ (k) $= \Theta_1 + (\epsilon^2) + \epsilon(k)$ with d given a sequence of N scalar in	$\begin{array}{c c} \hline & & \\ \hline \\ \hline$	In . If TE reg i.i.d. y(N),
9. In Qu (a) (a) (b) Given noise we w $y_N =$	the stion 18, what is the value of the state of the stat	triance of the variable y_N ? (b) $\square \frac{\sigma}{N}$ (k) $\square + \epsilon(k)$ with d given a sequence of N scalar in ear least squares (LLS) estimate w do we need to choose the mate 1 - x(1)	$\begin{array}{c c} \hline & & & \\ \hline \hline & & \\ \hline \hline \\ \hline & & \\ \hline \hline \\ \hline \hline & & \\ \hline \hline \\ \hline \hline & & \\ \hline \hline \\ \hline \hline \hline \hline \\ \hline \hline \hline \hline \hline \hline \\ \hline \hline$	In . If TE reg i.i.d. y(N),
 In Qu (a) Given noise we we	testion 18, what is the value of the second state of the second s	ariance of the variable y_N ? (b) $\Box \frac{\sigma}{N}$ (k) $= \Theta_1 + (e^{x}) + \epsilon(k)$ with d given a sequence of N scalar in ear least squares (LLS) estimate w do we need to choose the mate (b) $\Box \begin{bmatrix} 1 & -x(1) \\ \vdots & \vdots \end{bmatrix}$	$\begin{array}{c c} \hline & & \\ \hline \\ \hline$	In . If TE reg i.i.d. y(N),
$\begin{array}{c} \text{In Qu} \\ \hline \text{(a)} \\ \hline \text{(a)} \\ \text{(a)} \\ \text{(a)} \\ \hline \text{(a)} \\ \hline \end{array}$	testion 18, what is the value of the second	ariance of the variable y_N ? (b) $\Box \frac{\sigma}{N}$ (k) $\rightarrow \phi + \phi(k)$ with d given a sequence of N scalar in ear least squares (LLS) estimate w do we need to choose the mate (b) $\Box \begin{bmatrix} 1 & -x(1) \\ \vdots & \vdots \\ 1 & -x(N) \end{bmatrix}$	$\begin{array}{c c} & & & \\ \hline \hline & & \\ \hline & & \\ \hline & & \\ \hline \hline \\ \hline & & \\ \hline \hline & & \\ \hline \hline \\ \hline \hline & & \\ \hline \hline \\ \hline \hline \hline \\ \hline$	i.i.d. y(N), ² ₂ . If
). In Qu (a) (a) (a) (a) (a) (a) (a)	the stion 18, what is the value of the state of the stat	ariance of the variable y_N ? (b) $\Box \frac{\sigma}{N}$ (c) $\overline{\bigcirc} + (\epsilon)$ with d given a sequence of N scalar in ear least squares (LLS) estimation w do we need to choose the matrix (b) $\Box \begin{bmatrix} 1 & -x(1) \\ \vdots & \vdots \\ 1 & -x(N) \end{bmatrix}$ e dynamic system model $y(k)$ wn parameter vector $\theta = (\theta)$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	i.i.d. y(N), $\frac{2}{2}$. If $\epsilon(k)$ the the second
). In Qu (a) (a) (b) Given noise we w $y_N =$ (a) (a) (b) (a) (b) (c) (c) (c) (c) (c) (c) (c) (c	the stion 18, what is the value of the state of the stat	ariance of the variable y_N ? (b) $\Box \frac{\sigma}{N}$ (c) $\overline{\bigcirc} + (\epsilon)$ with d given a sequence of N scalar in ear least squares (LLS) estimation w do we need to choose the matrix (b) $\Box \begin{bmatrix} 1 & -x(1) \\ \vdots & \vdots \\ 1 & -x(N) \end{bmatrix}$ e dynamic system model $y(k)$ wn parameter vector $\theta = (\theta)$	$\frac{e_{X}(h)}{(c) \prod_{N=1}^{\sigma^2} \theta^2} \qquad \qquad$	i.i.d. y(N), $\frac{2}{2}$. If $\epsilon(k)$ the the second
$\begin{array}{c} \text{O. In Qu} \\ \hline (a) \\ \hline (a) \\ \hline (b) \\ O. Given noise we we$	testion 18, what is the value of the second sector 18, what is the value of the second sector 18, what is the value of the second sector 10, where $\frac{\sigma^2}{N}$ is the second sector 18, what is the value of the second sector 10, where $\frac{\sigma^2}{N}$ is the second secon	ariance of the variable y_N ? (b) $\Box \frac{\sigma}{N}$ (k) $= \Theta + (\epsilon^{*}) + \epsilon(k)$ with d given a sequence of N scalar in ear least squares (LLS) estimate w do we need to choose the matrix (b) $\Box \begin{bmatrix} 1 & -x(1) \\ \vdots & \vdots \\ 1 & -x(N) \end{bmatrix}$ e dynamic system model $y(k)$ wn parameter vector $\theta = (\theta)$ compute the estimate $\hat{\theta}_N$ by m	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	i.i.d. y(N), $\frac{2}{2}$. If $\epsilon(k)$ the the second
). In Qu (a) (a) (b) Given noise we w $y_N =$ (a) (a) (b) (a) (b) (c) (c) (c) (c) (c) (c) (c) (c	the stion 18, what is the value of the state of the stat	ariance of the variable y_N ? (b) $\Box \frac{\sigma}{N}$ (k) $= \Theta + (\epsilon^{*}) + \epsilon(k)$ with d given a sequence of N scalar in ear least squares (LLS) estimate w do we need to choose the matrix (b) $\Box \begin{bmatrix} 1 & -x(1) \\ \vdots & \vdots \\ 1 & -x(N) \end{bmatrix}$ e dynamic system model $y(k)$ wn parameter vector $\theta = (\theta)$ compute the estimate $\hat{\theta}_N$ by m	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	i.i.d. y(N), $\frac{2}{2}$. If $\epsilon(k)$ the the second
$\begin{array}{c} \text{O. In Qu} \\ \hline (a) \\ \hline (a) \\ \hline (b) \\ O. Given noise we we$	testion 18, what is the value of the second sector 18, what is the value of the second sector 18, what is the value of the second sector 10, where $\frac{\sigma^2}{N}$ is the second sector 18, what is the value of the second sector 10, where $\frac{\sigma^2}{N}$ is the second seco	ariance of the variable y_N ? (b) $\Box \frac{\sigma}{N}$ (k) $= \Theta + (\epsilon^{*}) + \epsilon(k)$ with d given a sequence of N scalar in ear least squares (LLS) estimate w do we need to choose the matrix (b) $\Box \begin{bmatrix} 1 & -x(1) \\ \vdots & \vdots \\ 1 & -x(N) \end{bmatrix}$ e dynamic system model $y(k)$ wn parameter vector $\theta = (\theta)$ compute the estimate $\hat{\theta}_N$ by m	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	i.i.d. y(N), $\frac{2}{2}$. If $\epsilon(k)$ the the second
$\begin{array}{c} \text{O. In Qu} \\ \hline (a) \\ \hline (a) \\ \hline (b) \\ O. Given noise we we$	testion 18, what is the value of the second	riance of the variable y_N ? (b) $\Box \frac{\sigma}{N}$ (k) $\rightarrow 0 + \epsilon(k)$ with d given a sequence of N scalar in ear least squares (LLS) estimate w do we need to choose the matrix (b) $\Box \begin{bmatrix} 1 & -x(1) \\ \vdots & \vdots \\ 1 & -x(N) \end{bmatrix}$ e dynamic system model $y(k)$ wn parameter vector $\theta = (\theta)$ compute the estimate $\hat{\theta}_N$ by m $(1, \dots, y(N))^T$, how do we need	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	i.i.d. y(N), $\frac{2}{2}$. If $\epsilon(k)$ the the second

S. Vary $= IE \left(\gamma - \overline{\gamma}\right) \left(\gamma - \overline{\gamma}\right)$ A IE (X - Z)(X - Z)- P A. (







