	TANTA UNIVERSITY FACULTY OF SCIENCE DEPARTMENT OF MATHEMATICS			
	EXAMINATION FOR SENIORS (FOURTH YEAR) STUDENTS OF STATISTICS			
	COURSE TITLE:	MULTIVARIATE STATISTICS		COURSE CODE: ST4206
DATE:	12-2020	TERM:	TOTAL ASSESSMENT MARKS: 150	TIME ALLOWED:2 HOURS

Answer the following questions:

1- a) Let $(X_1, X_2, \ldots, X_n)$ be an n-variate random variable. Define the joint conditional p.m.f. $p_{X_1/X_2,\ldots,X_n}(x_1/x_2, \ldots, x_n)$, the joint moment generating function, covariance matrix Σ, the joint c.d.f. and conditional correlation $\rho_{X_1X_2/X_3=x_3}$. (20 Marks)

b) Let $(X_1, X_2, \ldots, X_n)$ be an n-variate normal random variable. Show that if the covariance of X_i *and* X_j is zero for $i \neq j$, that is $\operatorname{cov}(X_i, X_j) = \sigma_{ij} = \begin{cases} \sigma_i^2, & i = j \\ 0, & i \neq j \end{cases}$,

then $X_1, X_2, \ldots, X_n$ are independent. (20 Marks)

c) If $X_1, X_2, \ldots, X_n$ are independent Bernoulli random variables X_i having parameter p, then find the distribution of $Y = X_1 + X_2 + \ldots + X_n$. (15 Marks)

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2- Consider the following joint p.d.f. $f(x_1, x_2, x_3) = k(x_1 + x_2 + x_3)$,

where $0 < x_1, x_2, x_3 < 1$.

a) Determine the constant k. (10 Marks)

b) Compute Σ. (30 Marks) **c)** Find the $\operatorname{cov}(X_1, X_2 / X_3)$. (10 Marks)

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3- a) Consider the scenario in which you toss a fair die 12 times. What is the probability that each face value (1-6) will occur exactly twice? (10 Marks)

b) Given $X_1, X_2, \ldots, X_n$ with joint p.d.f. $f_{X_1,X_2,\ldots,X_n}(x_1, x_2, \ldots, x_n) = \begin{cases} 1, & 0 \le x_i \le 1, i = 1,2,\ldots,n \\ 0, & otherwise \end{cases}$.

Let A denote the event that $\max_i X_i \le \frac{1}{2}$. Find $p(A)$. (15 Marks)

c) Consider the following joint p.d.f. $f(x_1, x_2, x_3) = (x_1 + x_2)e^{-x_3}$,

where $0 < x_1, x_2 < 1$, $x_3 > 0$.

Find the regression equation of X_2 *on* X_1 *and* X_3. (20 Marks)

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جامعة طنطا
كلية العلوم
المستوى الرابع (شعبة الإحصاء)

اسم المقرر: احصاء استخراج البيانات
المقرر: ST4208
الدرجة: 150

إمتحان نهاية الفصل الدراسي الأول لعام 2021/2020

Answer the following questions

Question 1 (30 marks)

Based on methods and models we have studied this semester, if you have a set of data what are the steps you will follow in order to model it?

Question 2 (30 marks)

Explain the simple and multiple linear regression models.

Question 3 (30 marks)

What is data smoothing? Show how you can use it in the additive model.

Question 4 (30 marks)

What is the difference between the additive model and linear regression model?

Question 5 (30 marks)

State the main equation of the regression tree model and explain its elements. Also show how you can choose the splitting points.

Good Luck

لجنة الممتحنين: د. حمدي عبدالمقصود أبوجبل
د. أحمد أبوزيد البنا

TANTA UNIVERSITY
FACULTY OF SCIENCE
DEPARTMENT OF MATHEMATICS
EXAMINATION FOR SENIORS STUDENTS (FOURTH YEAR) STUDENTS OF STATISTICS

COURSE TITLE: SELECTED TOPICS IN STATISTICS 2			COURSE CODE: ST4115	
DATE:9-1-2021	JON,...	TERM:SECOND	TOTAL ASSESSMENT MARKS:150	TIME ALLOWED: 2 HOURS

Answer five only of the following questions (each question of 30 marks):

1- If $f(x)=\frac{\lambda}{2}e^{-\lambda|x-\mu|}$, $-\infty<x,\mu<\infty$, $\lambda>0$ be the probability density function determine the characteristic function after that deduce the mean.

2- For the exponential distribution $f(x) = \lambda\, e^{-\lambda x}$ $where\ x > 0 , \lambda > 0$ find mode, median and entropy.

3- For the lognormal distribution $f(x)=\frac{e^{-\frac{1}{2}(\frac{\ln x-\mu}{\sigma})^2}}{\sigma\sqrt{2\pi}\,x}$, $x>0$, $\sigma>0$ and $-\infty<\mu<\infty$. find mean, variance and mode.

4- If $f(x)=\frac{1}{\sigma}e^{-\frac{x-\mu}{\sigma}-e^{-\frac{x-\mu}{\sigma}}}$, $-\infty<x,\mu<\infty$, $\sigma>0$ be the probability density function of extreme value distribution determine the cumulative distribution function after that deduce the median.

5- For T-distribution $f(t) = \frac{\left(1+\frac{t^2}{n}\right)^{-\frac{n+1}{2}}}{\sqrt{n}\,\beta\left(\frac{1}{2},\frac{n}{2}\right)}$ where n is a positive integer and the variable t is a real number, find the general moment about zero after that deduce the variance.

6- Let $f(r) = -\frac{(1-p)^r}{r\,\ln p}, r = 1,2, \cdots$, $0 \le p \le 1$ be the probability density function of logarithmic distribution, find the moment generating function after that deduce the mean.

7- Let $\varphi(t)=e^{-|t|}$ be the characteristic function for Cauchy distribution prove that the sum and the average of n independent and identical random variables of Cauchy distribution, are also follow Cauchy distribution.

EXAMINERS	PROF. DR./	DR/ ADEL EDRESS
	DR/	DR/

With my best wishes

TANTA UNIVERSITY
FACULTY OF SCIENCE
DEPARTMENT OF MATHEMATICS

EXAMINATION FOR FRESHMEN (FORTH YEAR) STUDENTS OF MATHEMATICAL STATISTIC

1969	COURSE TITLE:	Operations Research 2		COURSE CODE:
DATE:	FEB, 2021	TERM: FIRST	TOTAL ASSESSMENT MARKS:	TIME ALLOWED: 2 HOURS

Answer the following questions

1- i) Show that $f(X) = x_1^2 + x_2^2 + x_3^2 - 2x_1x_2$ is a positive semi-definite.

ii) Solve the following CNLP using K-T conditions

$$\max\ f(X) = 4x \ + 6x_2 - 2x_1^2 - 2x_2^2 - 2x_1x_2 + 49$$
$$\textit{subject to}\ \ x_1 + x_2 \le 2,$$
$$x_1,\ x_2 \ge 0.$$

2- Solve the problem $\min\ f(X) = x_1 - x_2 + 4x_1^2 + 3x_1x_2 + x_2^2$ with starting point at $x_1 = (0,0)$ by using:

i) The Newton method and
ii) The Fletcher-Reeves method.

3- i) By direct substitution method solves the NLPP

$$\min\ f(X) = 9 - 8x_1 - 6x_2 - 4x_3 + 2x_1^2 + 2x_2^2 + x_3^2 + 2x_1x_2 + 2x_1x_3$$
$$\textit{subject to}\ \ x_1 + x_2 + 2x_3 = 3.$$

ii) Find the bordered matrix for the problem

$$\min/\max\ \ Z = f(x_1, x_2, x_3)$$
$$\textit{subject to}\ \ g_1(x_1, x_2, x_3) = b_1,$$
$$g_2(x_1, x_2, x_3) = b_2.$$

مع اطيب امنياتي بالنجاح

	TANTA UNIVERSTIY - FACULTY OF SCIENCE - MATHEMATICS DEPARTMENT		
	EXAMINATION For 4^{TH} LEVEL (CHM-ZOOLOGY/ENTOMOLGY)		
	COURSE TITLE: Biostatistics (ST4107)		TIME ALLOWED: 2 Hours
DATE: 10 March 2021	TERM: First	TOTAL ASSESSMENT MARKS: 50	

Answer the following questions:

Q1: Listed below is the moisture content (by percent) for random samples of different fruits and vegetables. At $\alpha = 0.05$, can it be concluded that fruits differ from vegetables in average moisture content? **(10 Mark)**

Fruits	86	75	72	88	87	79	92	84
Vegetables	85	91	88	89	95	96	94	96

Q2: Ten people recently diagnosed with diabetes were tested to determine whether an educational program was effective in increasing their knowledge of diabetes. Test at $\alpha = 0.05$, before and after the educational program, concerning self-care aspects of diabetes. The scores on the test were as follows:

Before	75	62	67	70	55	59	60	64	72	59
After	77	65	68	72	62	61	60	67	75	68

(10 Mark)

Q3: Consider the contingency table below of observed values in a sample of 50 individual. *Test at* $\alpha = 0.05$, *is* there a dependency between the gender and blood type **(10 Mark)**

	A	B	AB	O
Male	10	10	15	5
Female	15	5	5	35

Q4: For the following data:

X	12	10	14	11	12	9
Y	18	17	23	19	20	15

Test at $\alpha = 0.05$, is there a significant positive correlation between the two variables? **(10 Mark)**

Q5: Listed below are measured amounts of greenhouse gas emissions from cars in three different categories. The measurements are in tons per year, expressed as CO equivalents.

4 cylinders	4.7	5.1	5.2		
6 cylinders	8.4	5.1	5.4	5.4	
8 cylinders	5.1	5.2	5.2	5.4	5.6

Determine whether there is significant difference between mean amount of greenhouse gas emissions. *at* $\alpha = 0.05$. **(10 Mark)**

You may use:

$F_{0.05,7,7} = 3.79$, $t_{0.05,19} = 1.729$, $t_{0.025,14} = 2.145$, $t_{0.05,12} = 1.782$, $t_{0.05,9} = 1.833$, $t_{0.05,4} = 2.132$

$F_{0.025,7,7} = 4.99$, $F_{0.05,2,9} = 4.26$, $z_{0.025} = 1.96$, $\chi^2_{(0.05,3)} = 7.81$

WITH ALL MY BEST WISHES

DR.WAFAA ANWAR

EXAMINERS	DR. WAFAA ANWAR ABD EL-LATIF	DR.MOHAMED M. EZZAT ABD EL MONSEF

1969	TANTA UNIVERSITY, FACULTY OF SCIENCE DEPARTMENT OF MATHEMATICS Final exam 1stterm2020		
	4th year, statistics	**Course Title:** Estimation Theory	**Course Code: ST4107**
	Date: 10-3- 2021	**Total Mark:** 100 Marks	**Time Allowed:** 2 Hours

Answer the following questions.

<u>**Q # (1)**</u>

a- Define: Invariance property of MLE; Posterior distribution; Method of moments estimation. (10 marks)

b. Find the MLEfor theθ of the exponential distribution $f(x;\theta) = \frac{1}{\theta} e^{-x/\theta};\ x > 0,$ $\theta > 0$. Also, CRLB and confidence interval of θ. (15 marks)

c. Given θ, the random variable Xhas the binomial distribution

$$f\left(\frac{x}{\theta}\right) = \binom{2}{x} \theta^x (1-\theta)^{2-x}, x = 0,1,2; 0 < \theta < 1,$$

and the prior distribution of θ is $h(\theta) = 2;\ \ 0.5 < \theta < 1$. Using a squared loss function, Find the Bayes estimator of $\theta, if\ X = 1$. (15 marks)

<u>**Q # (2)**</u>

a- If the prior distribution of a parameter θ is Uniform over (2,5). Given θ, the rv X is Uniform over $(0,\theta)$. Find the Bayes estimator of θ for an absolute loss function assuming $X=1$. (10 marks)

b- Given the Poisson distribution $p(x) = \frac{e^{-\lambda}\lambda^x}{x!}; x = 0,1,2\ldots, \lambda > 0$, find the estimator of $\lambda$by the moment generating methodand find the value of this estimator for a sample whose values: 1, 3, 4, 3, 5, 2, 2, 1,2, 5, 2,7 at$t=1$.(10 marks)

c- What is the basic principle of the MLE? (10 marks)

<u>**Q # (3)**</u>

If $X_1, X_2, \ldots, X_n$ is a random sample from $N(\theta_1, \theta_2)$, where $-\infty < \theta_1 < \infty$, $\theta_2 > 0$, and θ_1, θ_2 are the mean and variance of this distribution, respectively.

i. Find the maximum likelihood estimator (MLE) ofθ_1, θ_2. (15 marks)

ii. Get the variance-covariance matrix of the estimators; and the **covariance between them.** (15 marks)

Best wishes

Examiners	*Pof. Dr. Hassan S. Bakouch, Dr. Omnia G. Elbarbary*

TANTA UNIVERSITY
FACULTY OF SCIENCE
DEPARTMENT OF MATHEMATICS

MIDTERM EXAMINATION FOR PROSPECTIVE STUDENTS (FOURTH YEAR) STUDENTS OF STATISTICS

COURSE TITLE: NONPARAMETRIC STATISTICS			COURSE CODE: ST4101	
DATE:	JAN 2021	TERM: FIRST	TOTAL ASSESSMENT MARKS: 150	TIME ALLOWED: 2 HOURS

Answer the following questions:

(1) a- If X_1, X_2, X_3 is a random sample from the uniform distribution on $(0, b)$, then find probability density function (pdf) of the sample median and the expectation of the sample median. (20 Marks)

b- Let Y_1, Y_2, Y_3, Y_4, Y_5 denote the order statistics of a random sample of size 5 from a population with a pdf: $f(x) = 2x$, $0 < x < 1$. Find the pdf of Y_5 and $p(Y_5 > 0.8)$. (20 Marks)

c- Define: population, order statistics, parameter, statistic. random sample. (10 Marks)

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(2) a- Let the data of the sample are:
H H H H H I I I H H H H H H I I H H I I I I H H H H I I. Test that H_o: the sample is random against H_1: the sample is not random at $\alpha = 0.05$. (20 Marks)

b- The following data represent the time, in minutes, that a patient has to wait during 12 visits to a doctor's office before being seen by the doctor:
17 15 20 20 32 28 12 26 25 25 35 24
Use the sign test at $\alpha = 0.05$ to test that the doctor's claim that the median waiting time for her patients is not more than 20 minutes before being admitted to the examination room (i.e., test the hypothesis that $\nu = 20$ against H_1: $\nu < 20$). (20 Marks)

****

(3) a- It is claimed that a new diet will reduce a person's weight by 4.5 kilograms, on average, in a period of 2 weeks. The weights of 10 women who followed this diet were recorded before and after a 2-week period yielding the following data:

Weight Before:	58.5	60.3	61.7	69.0	64.0	62.6	56.7	63.6	68.2	59.4
Weight After:	60.0	54.9	58.1	62.1	58.5	59.9	54.4	60.2	62.3	58.7

Use the signed-rank test at the $\alpha = 0.05$ to test the hypothesis that $\nu_1 = \nu_2$ against H_1: $\nu_1 < \nu_2$. (20 Marks)

b- Estimate the quantile $X_{0.50}$ from a random sample with size 49. (20 Marks)

c- Find the confidence interval for the median if the sample size is 10 and $\alpha = 0.05$. (20 Marks)

****

$$Z_{0.05} = 1.645 \text{ , } Z_{0.025} = 1.96$$

Examiners	Dr. Hamdy M. Abou-Gabal	Dr. Abd El-Moneim Anwer

TANTA UNIVERSITY
FACULTY OF SCIENCE
DEPARTMENT OF MATHEMATICS
MIDTERM EXAMINATION FOR PROSPECTIVE STUDENTS (FOURTH YEAR) STUDENTS OF STATISTICS

COURSE TITLE: NONPARAMETRIC STATISTICS		COURSE CODE: ST4101	
DATE: JAN 2021	TERM: FIRST	TOTAL ASSESSMENT MARKS: 150	TIME ALLOWED: 2 HOURS

Answer the following questions:

(1) a- If X_1, X_2, X_3 is a random sample from the uniform distribution on $(0,b)$, then find probability density function (pdf) of the sample median and the expectation of the sample median. (20 Marks)

b- Let Y_1, Y_2, Y_3, Y_4, Y_5 denote the order statistics of a random sample of size 5 from a population with a pdf: $f(x) = 2x$, $0 < x < 1$. Find the pdf of Y_5 and $p(Y_5 > 0.8)$. (20 Marks)

c- Define: population, order statistics, parameter, statistic. random sample. (10 Marks)

****

(2) a- Let the data of the sample are:

H H H H H I I I H H H H H H I I H H I I I I H H H H I I. Test that H_o: the sample is random against H_1: the sample is not random at $\alpha = 0.05$ (20 Marks)

b- The following data represent the time, in minutes, that a patient has to wait during 12 visits to a doctor's office before being seen by the doctor:

17 15 20 20 32 28 12 26 25 25 35 24

Use the sign test at $\alpha = 0.05$ to test that the doctor's claim that the median waiting time for her patients is not more than 20 minutes before being admitted to the examination room (i.e., test the hypothesis that $\nu = 20$ against H_1: $\nu < 20$). (20 Marks)

****

(3) a- It is claimed that a new diet will reduce a person's weight by 4.5 kilograms, on average, in a period of 2 weeks. The weights of 10 women who followed this diet were recorded before and after a 2-week period yielding the following data:

Weight Before: 58.5 60.3 61.7 69.0 64.0 62.6 56.7 63.6 68.2 59.4
Weight After: 60.0 54.9 58.1 62.1 58.5 59.9 54.4 60.2 62.3 58.7

Use the signed-rank test at the $\alpha = 0.05$ to test the hypothesis that $\nu_1 = \nu_2$ against H_1: $\nu_1 < \nu_2$. (20 Marks)

b- Estimate the quantile $X_{0.50}$ from a random sample with size 49. (20 Marks)

c- Find the confidence interval for the median if the sample size is 10 and $\alpha = 0.05$. (20 Marks)

****

$$Z_{0.05} = 1.645, \; Z_{0.025} = 1.96$$

Examiners	Dr. Hamdy M. Abou-Gabal	Dr. Abd El-Moneim Anwer

جامعة طنطا
كلية العلوم
قسم الرياضيات

امتحان الطلاب المستجدون – المستوى الرابع – شعبة احصاء

اسم المقرر: إستدلال احصائي ٢ | كود المقرر: ST4105

زمن الامتحان: ساعتان | الدرجة الكلية للامتحان: ١٥٠ | الفصل الدراسي: الأول | التاريخ: ٣٠ يناير ٢٠٢١

أجب عن الأسئلة التالية :

السؤال الأول عينة عشوائية حجمها 20 أخذت من مجتمع طبيعي فأعطت تباين 35 فأوجد فترة 95% ثقة لتباين المجتمع.ثم اختبر الفرض القائل أن تباين المجتمع يختلف عن 30 عند مستوى معنوية $\alpha = 0.05$.

السؤال الثاني للمقارنة بين أعمار نوعين من اطارات السيارات المنتجة بواسطة مصنعين مختلفين . اختيرت عينة من الاطارات المنتجة بواسطة كل مصنع وجربت فكانت مشاهدات العينتين كما يلي

المصنع الأول 102 86 98 109 92

المصنع الثاني 81 165 97 134 92 87 114

وبفرض أن أعمار الأطارات المنتجة بواسطة المصنعين تتبع توزيعا طبيعيا اختبر الادعاء بأن تبايني المجتمعين متساويان مستخدما مستوى معنوية $\alpha = 0.02$.

السؤال الثالث في تجربة لاختبار نوع من الدواء لتخفيض ضغط الدم عند الافراد تم اختيار عينة من خمسة افراد و أعطي لهم الدواء فكانت نتائج ضغط دمهم قبل وبعد تناول الدواء كما يلي :

قبل الدواء	120	136	160	98	115
بعد الدواء	118	122	143	105	98

استخدم مستوى معنوية $\alpha = 0.02$. لاختبار الفرض أن الدواء غير مؤثر وذلك بافتراض أن ضغط الدم قبل وبعد تناول الدواء يتبع توزيعا طبيعيا.

السؤال الرابع ألقيت زهرة نرد 120 مرة متتالية فحصلنا علي النتائج التالية:

عدد النقاط	1	2	3	4	5	6
عددالمرات	15	19	26	20	18	22

هل يمكن القول أن هذا الزهر غير متحيز؟ استخدم مستوى معنوية $\alpha = 0.05$ ..

السؤال الخامس لدراسة العلاقة بين لون الشعر ولون العيون في احدي المناطق تم اختيار عينة من 400 شخص وتم تصنيفهم في جدول التوافق التالي :

لون العيون / لون الشعر	بني	أخضر	أزرق
اسود	50	54	41
بني	38	46	132
أشقر	22	30	31
أحمر	10	10	20

هل يمكن القول أنه لايوجد علاقة بين لون الشعر ولون العيون ؟ استخدم مستوى معنوية $\alpha = 0.01$ ..

$t_{4,0.01} = 3.747$, $F_{0.01}(4,6) = 9.15$, $Z_{0.01} = 2.33$, $Z_{0.025} = 1.96$, $Z_{0.05} = 1.645$, $F_{0.01}(6,4) = 15.21$, $\chi^2_{0.05,5} = 11.070$, $\chi^2_{0.01,6} = 16.812$, $\chi^2_{0.025,19} = 30.144$, $\chi^2_{0.975,19} = 10.117$

الممتحنون: د/ عادل محمد ادريس

مع أطيب الأمنيات بالتوفيق والنجاح

TANTA UNIVERSITY
FACULTY OF SCIENCE
DEPARTMENT OF MATHEMATICS

EXAMINATION FOR PROSPECTIVE STUDENTS (4 YEAR) STUDENTS OF STATISTICS

COURSE TITLE: RELIABILITY THEORY			COURSE CODE: ST4103
DATE 17-3-2021	TERM: 1	TOTAL ASSESSMENT MARKS: 150	TIME ALLOWED: 2 HOURS

Answer the following questions:

1- (a) Consider the reliability function is given by:

$$R(t) = e^{-\lambda t^2}\ , \quad t \geq 0$$

Find $F(t), f(t), h(t)$, and MTTF **(25 points)**

(b) Let discrete lifetime $T \sim Geometric(p)$. **Find** $F(t), R(t), h(t)$ ***and MTTF***

(25 points)

2- (a) Let T_1, T_2 ***are independent lifetimes and*** $T_i \sim exp(\lambda_i), i = 1, 2$
Find the reliability, MTTF, and failure rate of ***lifetime*** $T = T_1 + T_2$

(25 points)

(b)The lifetime T in hours o f a unit is modeled by pdf $f_T(t) = 2\lambda\, t\, exp(-\lambda t^2)$
t>0, determine parameter λ ***if*** $P(T < 100 | T \geq 90) = 0.15$

(25 points)

3- (a) System has three identical components in series with CFR of λ. We want $R_S(100) = 0.85$**. What should component MTTF be?.**

(25 points)

(b) 40 light bulbs were tested and the failures in 300 hours intervals are

Time intervals (hours)	$0 < t \leq 300$	$300 < t \leq 600$	$600 < t \leq 900$	$900 < t \leq 1200$	$t > 1200$
Failure in the intervals	16	12	8	4	0

Find the computation of $\widehat{R}(t), \widehat{F}(t), \widehat{f}(t)$ **and** $\widehat{h}(t)$ **measures for the light bulb test data**

(25 points)

لجنة الممتحنين	أ.د/ مدحت أحمد الدمسيسي
	د/ شريف إبراهيم البنداري

TANTA UNIVERSITY
FACULTY OF SCIENCE
DEPARTMENT OF MATHEMATICS

EXAMINATION FOR PROSPECTIVE STUDENTS (4 YEAR) STUDENTS OF STATISTICS			
COURSE TITLE: RELIABILITY THEORY		COURSE CODE: ST4103	
DATE 17-3-2021	TERM: 1	TOTAL ASSESSMENT MARKS: 150	TIME ALLOWED: 2 HOURS

Answer the following questions:

1- (a) Consider the reliability function is given by:

$$R(t) = e^{-\lambda t^2}, \quad t \geq 0$$

Find $F(t), f(t), h(t)$, and MTTF **(25 points)**

(b) Let discrete lifetime $T \sim Geometric(p)$**. Find** $F(t), R(t), h(t)$ *and MTTF*
(25 points)

2- (a) Let T_1, T_2 *are independent lifetimes and* $T_i \sim exp(\lambda_i), i = 1, 2$
Find the reliability, MTTF, and failure rate of *lifetime* $T = T_1 + T_2$
(25 points)

(b)The lifetime T in hours o f a unit is modeled by pdf $f_T(t) = 2\lambda\, t\, exp(-\lambda t^2)$ **t>0, determine parameter** λ *if* $P(T < 100 | T \geq 90) = 0.15$
(25 points)

3- (a) System has three identical components in series with CFR of λ. We want $R_S(100) = 0.85$. What should component MTTF be?.
(25 points)

(b) 40 light bulbs were tested and the failures in 300 hours intervals are

Time intervals (hours)	$0 < t \leq 300$	$300 < t \leq 600$	$600 < t \leq 900$	$900 < t \leq 1200$	$t > 1200$
Failure in the intervals	16	12	8	4	0

Find the computation of $\hat{R}(t), \hat{F}(t), \hat{f}(t)$ **and** $\hat{h}(t)$ **measures for the light bulb test data**
(25 points)

لجنة الممتحنين	أ.د/ مدحت أحمد الدمسيسي
	د/ شريف إبراهيم البنداري