MINITAB tutorial TA session

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- Calculator, basic statistics, histogram, boxplot, percentile in a column of data
- Probability distribution,
- Random data, row statistics, column statistics, monte carlo, bootstrap
- T-test, z test, power analysis, probability plot
- Control charts
- Scatter plot, regression

1. Calculator, basic statistics, histogram, boxplot

- Problem #2 in Exam #1:
- Open the MINITAB data set PulseA.MTW

Open the MINITAB data set PulseA.MTW

(a) Obtain side-by-side box plots of Pulse 2(Column C2) versus Activity (Col. C8). Find:

: IQR =

• Which Activity level (1, 2 or 3) has highest IQR?

Activity level

• Which Activity level has highest Median?

Activity level ; Median=

• Are there any outliers? If so, identify:

Activity level(s) ; high or low side?

Outlier=

(b) Construct a new column of the difference:

DIFF = Pulse 2 - Pulse 1

Obtain the following descriptive statistics of DIFF classified by sex (col. C5):

Variable	Sex	N	Mean	St Dev	IQR	Coeff Var
DIFF	Female					
	Male					

(c) For the over-all weight (Col. C7), find approx. values of

51st percentile =

63rd percentile =

(d) Find Prob[DIFF > 12]=

(e) Check the normality of Weight (Col C7): p-value = _____

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Pul	ieA.MTW ***																		
Pul	eA.MTW ***	C2	C3-T	C4-T	C5-T	C6	C7	C8-T	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	С
Pul	C1 Pulse1	C2 Pulse2	C3-T Ran	C4-T Smokes	C5-T Gender	C6 Height	C7 Weight	C8-T Activity	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul	C1 Pulse1 64	C2 Pulse2 88	C3-T Ran Ran	C4-T Smokes NonSmoker	C5-T Gender Male	C6 Height 66.00	C7 Weight 140	C8-T Activity Moderate	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul • 1	C1 Pulse1 64 58	C2 Pulse2 88 70	C3-T Ran Ran Ran	C4-T Smokes NonSmoker	C5-T Gender Male Male	C6 Height 66.00 72.00	C7 Weight 140 145	C8-T Activity Moderate Moderate	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul • 1	C1 Pulse1 64 58 62	C2 Pulse2 88 70 76	C3-T Ran Ran Ran Ran	C4-T Smokes NonSmoker Smoke	C5-T Gender Male Male	C6 Height 66.00 72.00 73.50	C7 Weight 140 145 160	C8-T Activity Moderate ALot	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul • 1 2 3	C1 Pulse1 64 58 62 66	C2 Pulse2 88 70 76 78	C3-T Ran Ran Ran Ran Ran	C4-T Smokes NonSmoker NonSmoker Smoke Smoke	C5-T Gender Male Male Male	C6 Height 66.00 72.00 73.50 73.00	C7 Weight 140 145 160 190	C8-T Activity Moderate ALot Slight	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul 1 2 3 4 5	C1 Pulse1 64 58 62 66 64	C2 Pulse2 88 70 76 78 80	C3-T Ran Ran Ran Ran Ran Ran	C4-T Smokes NonSmoker NonSmoker Smoke Smoke NonSmoker	C5-T Gender Male Male Male Male	C6 Height 66.00 72.00 73.50 73.00 69.00	C7 Weight 140 145 160 190 155	C8-T Activity Moderate ALot Slight Moderate	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul 1 2 3 4 5 6	C1 Pulse1 64 58 62 66 64 74	C2 Pulse2 88 70 76 78 80 84	C3-T Ran Ran Ran Ran Ran Ran Ran Ran	C4-T Smokes NonSmoker Smoke Smoke NonSmoker NonSmoker	C5-T Gender Male Male Male Male Malo Malo	C6 Height 66.00 72.00 73.50 73.00 69.00 73.00	C7 Weight 140 145 160 190 155 165	C8-T Activity Moderate ALot Slight Moderate Slight	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul 1 2 3 4 5 6 7	C1 Pulse1 64 58 62 66 64 74 84	C2 Pulso2 88 70 76 78 80 84 84	C3-T Ran Ran Ran Ran Ran Ran Ran Ran	C4-T Smokes NonSmoker NonSmoker Smoke NonSmoker NonSmoker	C5-T Gender Male Male Male Malo Male Male Male	C6 Holght 66.00 72.00 73.50 73.00 69.00 73.00 73.00 72.00	C7 Weight 140 145 160 190 155 165 165	C8-T Activity Moderate ALot Slight Moderate Slight ALot	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul 1 2 3 4 5 6 7 8	C1 Pulse1 64 58 62 66 64 74 84 68	C2 Pulse2 88 70 76 78 80 84 84 84 84 72	C3-T Ran Ran Ran Ran Ran Ran Ran Ran	C4-T Smokes NonSmoker Smoke Smoke NonSmoker NonSmoker NonSmoker	C5-T Gender Male Male Male Male Male Male Male	C6 Holght 66.00 72.00 73.50 73.00 69.00 73.00 72.00 74.00	C7 Weight 140 145 160 190 155 165 150 190	C8-T Activity Moderate Moderate ALot Slight Moderate Slight ALot Moderate	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul → 1 2 3 4 5 6 7 8 9	C1 Pulso1 64 58 62 66 64 74 84 84 68 62 27	C2 Pulse2 88 70 76 78 80 84 84 84 72 75	C3-T Ran Ran Ran Ran Ran Ran Ran Ran Ran	C4-T Smokes NanSmoker Smake Smake NanSmaker NanSmaker NanSmaker	C5-T Gender Male Male Male Male Male Male Male Male	C6 Height 66.00 72.00 73.00 69.00 73.00 73.00 72.00 74.00 72.00	C7 Weight 140 145 160 190 165 165 165 150 190 195	C8-T Activity Moderate ALot Slight Moderate Slight ALot Moderate Moderate	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul • 1 2 3 4 5 5 7 3 9 0	C1 Pulse1 64 58 62 66 64 74 84 68 62 76	C2 Pulse2 88 700 76 78 80 84 84 84 72 75 118	C3-T Ran Ran Ran Ran Ran Ran Ran Ran Ran Ran	C4-T Smokes NonSmoker NanSmoker Smoke NanSmoker NanSmoker NanSmoker NanSmoker	C5-T Gender Male Male Male Male Male Male Male Male	C6 Height 66.00 72.00 73.50 69.00 73.00 72.00 74.00 72.00 71.00	C7 Weight 140 145 160 190 155 155 150 190 195 138	C8-T Activity Moderate ALot Slight Moderate Slight ALot Moderate Moderate Moderate	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul 1 2 3 1 5 5 7 3 9 0 1	C1 Pulse1 64 58 62 66 64 74 84 68 62 76 90	C2 Pulse2 88 70 76 76 88 80 84 84 72 75 118 94	C3-T Ran Ran Ran Ran Ran Ran Ran Ran Ran Ran	C4-T Smokes NonSmoker Smoke Smoke NonSmoker NonSmoker NonSmoker NonSmoker NonSmoker Smoke	C5-T Gender Male Male Male Male Male Male Male Male	C6 Hoight 66.00 72.00 73.00 69.00 73.00 73.00 72.00 74.00 71.00 74.00	C7 Weight 140 145 160 190 155 165 150 190 195 138 160	C8-T Activity Moderate Moderate Slight Moderate Slight ALot Moderate Slight Moderate Slight	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C
Pul Pul 1 2 3 4 5 6 7 8 9 10 11 ent 1	C1 Pulse1 64 58 62 66 64 74 84 68 62 76 90 Vorkshett PU	C2 Pulse2 88 70 76 78 80 84 84 75 118 94 94	C3-T Ran Ran Ran Ran Ran Ran Ran Ran Ran Ran	C4-T Smokes NonSmoker NonSmoker Smoke Smoke NonSmoker NonSmoker NonSmoker NonSmoker NonSmoker Smoke	C5-T Gender Male Male Male Male Male Male Male Male	C6 Height 66.00 72.00 73.50 73.00 73.00 73.00 72.00 74.00 71.00 74.00	C7 Weight 140 145 160 190 155 150 190 195 138 160	C8-T Activity Moderate ALot Slight Moderate Moderate Moderate Moderate Slight	C9	C10	C11	C12	C13	C14	C15	C16	C17 Editable	C18	
	C1 Pulse1 64 58 62 66 64 74 84 68 62 76 90 Vorishect P	C2 Pulso2 88 70 76 78 84 84 84 72 75 118 94 94 94	C3-T Ran Ran Ran Ran Ran Ran Ran Ran Ran Ran	C4-T Smokes NonSmoker Smoke Smoke NonSmoker NonSmoker NonSmoker NonSmoker NonSmoker NonSmoker Smoke	C5-T Gender Male Male Male Male Male Male Male Male	C6 Height 66.00 72.00 73.50 73.00 69.00 73.00 73.00 72.00 74.00 74.00 74.00	C7 Weight 140 145 160 190 165 165 150 190 195 138 160	C8-T Activity Moderate ALot Slight Moderate Slight Moderate Moderate Slight	C9	C10	C11	C12	C13	C14	C15	C16	C17 Editable	C18	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

Calculator

Calc->Calculator



Calculato	r								×
C1 C2 C3 C4 C5 C6 C7 C8	Pulse1 Pulse2 Ran Smokes Gender Height Weight Activity	Store result in variable: DIFF Expression: 'Pulse2' - 'Pulse1'							
		,						Functions:	
		7	8	9	+	=	\diamond	All functions	•
		4	5	6	-	<	>	Absolute value	~
		1	2	3	*	<=	>=	Arcsine Arccosine	
			0	•	1	A	nd	Arctangent Ceiling	
I					**	C)r	Cosine Current time	-
	Select				0	N	ot	Select	
Н	elp							OK Can	cel

Basic statistics

1. Stat->Basic Statistics->Display Descriptive Statistics

<u>File E</u> dit D <u>a</u> ta <u>C</u> alc	Stat Graph Editor Tools	<u>W</u> indow <u>H</u> elp
🖻 🖬 🏉 🐰 🖻	Basic Statistics	R Display Descriptive Statistics
@	Regression	► Store Descriptive Statistics
Session	<u>A</u> NOVA	• 뿔튼 <u>G</u> raphical Summary
4/18/2	<u>C</u> ontrol Charts Quality Tools	1z 1-Sample <u>Z</u>
Worksheet size: 1	Time Series	1T 1-Sample t
	Tables	2T 2-Sample t
Welcome to Minita	Nonparametrics	tet Pared t
1	Power and Sample Size	• 1P 1 Proportion
		2P 2 Proportions
		σ ⁱ _{σ²} 2 V <u>a</u> riances
		COR Correlation
		COV Covariance
		Arrest Normality Test

3. In Statistics, we can choose information

2. Input variables and By variables(optional) we want

Display Descriptive Statistics		Descriptive Statistics - Statistics	\$7.00 C		22
Variables:		🔽 Mean	🗆 Trimmed mean	V N	Inonmissing
DIFF		🔽 SE of mean	🗆 Sum	🔽 N	l missing
· ·		✓ Standard deviation	🗹 Minimum	🗆 N	l total
By variables (ontional)		🗆 Variance	🔽 Maximum	□ C	umulative N
Gender		Coefficient of variation	🗆 Range		ercent
				□ C	umulative percent
· · · · · · · · · · · · · · · · · · ·		First quartile	Sum of squares	:	
		🔽 Median	Skewness		
		🔽 Third quartile	🗆 Kurtosis		
		🔲 Interquartile range	🗆 MSSD		
Select Statistics Graphs	-				
Help OK Cancel	ļ	Help		ОК	Cancel

Histogram

• Graph-> Histogram

Input the variable

Histograms	Histogram - Simple	×	
Simple With Fit	C1 Pulse1 C2 Pulse2 C6 Height C7 Weight C9 DIFF	Graph variables:	
With Dutline With Fit and Groups and Groups	Select	Scale Labels Data View Multiple Graphs Data Options]
Help OK Cancel	Help	OK Cancel	J

Obtain side-by-side boxplot of Pulse2 vs. Activity



When the mouse is over the plot, Q1 etc. will show up. The same to outliers.

Percentile in a column of data

Data-> Rank

	Student - Untitled
<u>F</u> ile <u>E</u> dit	Data Calc Stat Graph Editor
🖻 🖬 🤞	🚛 Su <u>b</u> set Worksheet
(m)	器 S <u>p</u> lit Worksheet
Session	Merge Worksheets
Results	<u>С</u> ору •
Descrip	[→] <u>U</u> nstack Columns
Variable	Stack
DIFF	Transpose Columns
	<mark>⊉↓</mark> <u>S</u> ort
Variabl∉ DIFF	³ 1 ₂ <u>R</u> ank
	} [▶] Delete Rows
	\mathcal{Q}_{var} Erase Variables
Boxplot	C <u>o</u> de
	C <u>h</u> ange Data Type 🔹 🕨
	Extract from Date/Time 🔸
	A _B Co <u>n</u> catenate
PulseA.	Display Data

51st Percentile in 'Weight'= ?

Total # in 'Weight' is 92. The 51st percentile is the 92*51%=46.92th number. Find a number in WeightRank close to 46.92, the answer is the according Weight.

Rank	×
C1 Pulse1 C2 Pulse2 C6 Height C7 Weight C9 DIFF	Rank data in: Weight Store ranks in: WeightRank
Select Help	OK Cancel

→	C1	C2	C3-T	C4-T	C5-T	C6	C7	C8-T	C9	C10
	Pulse1	Pulse2	Ran	Smokes	Gender	Height	Weight	Activity	DIFF	WeightRank
1	64	88	Ran	NonSmoker	Male	66.00	140	Moderate	24	39.5
2	58	70	Ran	NonSmoker	Male	72.00	145	Moderate	12	45.0

2. Probability distribution

• Example: Problem 3 in Exam #1

Problem 3

[A] Using MINITAB, evaluate the following: a. For X~Bin(n=15,p=.45) p[x=7] = . $p[x \le 6] =$. p[x>5] = . b. For X~Normal with $\mu = 11, \sigma = 2.5$ P[x < 8] = _____. 81st percentile = . c. For Y ~ Poisson, with $\lambda = 10$ P[x > 8] =_____. P[x = 5] = . d. For X~exponential, with $\lambda = 5$ Mean = _____. Median = _____.

Probability distribution

- Discrete
 - Binomial
 - Poisson
- Continuous
 - Normal
 - Exponential
 - Gamma





					Normal Distribution	×
Ν	0	rm	nal			C Probability density C Cumulative probability Inverse cumulative probability Mean: 11 Standard deviation: 2.5
b. For	X~Norn	nal with μ	$= 11, \sigma = 2.5$	_		O Input column:
P[x < 8	3] =					
81 st pe	ercentile	9 =	{ .		Select	Optional storage:
alc <u>S</u> tat (Calculato	<u>G</u> raph E <u>d</u> ii)r Statistics	tor <u>T</u> ools <u>W</u> i	ndow <u>H</u> elp		Help	OK Cancel
Row Sta Standard	tistics lize	-			Normal with me	an = 11 and standard deviation = 2
Make <u>P</u> a	tterned Da dicator Vari	ta •			x P(X <= x) 8 0.115070	
Set <u>B</u> ase)					
Probabili	ty <u>D</u> istribut	ions 🕨	Chi-Square		Normal Distribution	
<u>M</u> atrices			<u>N</u> ormal <u>E</u>			C Probability density C Cumulative probability
			<u>t</u> <u>U</u> niform			Inverse cumulative probability
			<u>B</u> inomial			Mean: 11
			Hypergeometric	N N		Standard deviation: 2.5
			Discrete			
C2	C3-T	C4-T	Poisson			C Input column:
Pulse2	Ran	Smokes	t			Optional storage:
88	Ran	NonSmoke	Bet <u>a</u>			Input constant: 81
70	Ran	Smoke	Exponential			
79	Ran	Smoke	Gamma		Select	opuonai storage:
80	Ran	NonSmoke	Laplace r			
84	Ran	NonSmoke	Largest Extreme Value		Help	OK Cancel
84	Ran	NonSmoke	Logistic			
72	Ran	NonSmoke	Loglogistic		Normal with mea	an = 11 and standard deviation = 2
75	Ran	NonSmoke	Lognormal		NOTIMET WIGH MCC	II and boundard deviation - 2.
118	Ran	NonSmoke	Smallest Extreme Value.		P(X <= v)	v
94	Ran	Smoke	Triangular		0.91 13	2 10/7
96	Ran	NonSmoke	Weibull		0.01 13).134/
84	Ran	Smoke				



3. Random data, column statistics, row statistics, monte carlo

• For example Prob. 3 in Exam 2

[A] The lifetime of three lamps is exponentially distributed with means 120, 160 and 130 hours respectively. If they are placed in parallel in a system, estimate (using Monte Carlo simulation with 500 iterations), the

(a) Prob[system lifetime > 150] = _____.

(b) Is the probability distribution of system lifetime

Normal?______.

Exponential? ______.

Gamma? ______ .

How do you check this? Give p values.

[B] The acceleration g due to gravity is measured by dropping an object and measuring the time t it takes to travel a distance S. Assuming s and t are normally distributed with means and uncertainties as indicated:

$$s = 2.2 \pm 0.01m$$

$$t = 0.67 \pm 0.015s$$

(i) Estimate (using Monte Carlo simulation with 500 iterations), g and its uncertainty.

g = _____ ± ____ [Hint: $s = \frac{1}{2}gt^2$]

(ii) Run an Exec file (100 iterations) on the mean value of g. Find the average.Copy the exec file.

Random data

(a) Prob[system lifetime > 150] =

[A] The lifetime of three lamps is exponentially distributed with means 120, 160 and 130 hours respectively. If they are placed in parallel in a system, estimate (using Monte Carlo simulation with 500 iterations), the

(a) Probl syste	m lifetime > 150]	=	·	C1	C2	C3
<u>Calc Stat G</u> raph E <u>d</u> itor <u>T</u> ools	<u>W</u> indow <u>H</u> elp	Generate	e x.v.z columns of data	x	у	z
Calculator	A 🛇 ? 🗊	Exponential Distribution	×	198.169	68.984	94.73
Row Statistics			Generate 500 rows of data	188 082	1,885	77.73
<u>S</u> tandardize				15 000	270.001	122.00
Make Patterned Data	•		Store in column(s):	15.990	219.901	152.05
Make Indicator Variables			X	265.590	21.292	135.30
Set <u>B</u> ase	Sample From Columns			227.518	126.934	86.40
Probability <u>D</u> istributions	Chi Caussa			256 802	285 487	27.64
<u>1</u> atrices	Normal			400.042	47.400	400.00
	 Multivariate Normal		Scale: [120] [= Mean when Threshold = 0]	138.813	17.422	163.50
	E····		Threshold: 0.0	103.351	62.350	14.05
	<u>t</u>			236 884	75 233	37 44
	Bernoulli	Select		110 101	10.700	464.50
	Binomial	Help	OK Cancel	112.131	19.700	101.52
	 Hypergeometric			166 /17	E0 774	EO 13
	Discrete					
	Integer					
	Poisson					
	Bet <u>a</u>					
C2 C3 C4	Cauchy					
	E <u>x</u> ponential					
	<u>G</u> amma					
	Laplace					
	Largest Extreme Value					
	Logistic					
	Loglogi <u>s</u> tic					
	Lognor <u>m</u> al					
	Smallest Extreme <u>V</u> alue					
	i <u>r</u> iangular					
	vveibull					

C1 C2

Row statistics

Calc-> Row Statistics





	x	У	z	w
	198.169	68.984	94.73	198.17
	188.082	1.885	77.73	188.08
	15.990	279.901	132.09	279.90
	265.590	21.292	135.30	265.59
	227.518	126.934	86.40	227.52
	256.802	285.487	27.64	285.49
	138.813	17.422	163.50	163.50
1	402.254	60.250	44.05	102.25

Column statistics

[A] The lifetime of three lamps is exponentially distributed with means 120, 160 and 130 hours respectively. If they are placed in parallel in a system, estimate (using Monte Carlo simulation with 500 iterations), the

(a) Prob[system lifetime > 150] = _____.

Calculator	Column Statistics
C1 xC2 yStore result in variable: checkC3 zFypession' $(4 v)$ $[w' > 150]$ $w' > 150]$ Functions:7 8 9 + = $(>)$ All functions \checkmark 4 5 6 - $(>)$ Absolute value Antilog Arcsine1 2 3 * $(=)$ = $=$	Statistic Sum Median Median Sum of squares Standard deviation Minimum Minimum Maximum Range Input variable: check
0 / And Arctangent Colling Cosine Current time Select () Not Select	Store result in: [Optional] Select Help OK Cancel

Mean of check

Mean of check = 0.7

1. Generate 2 columns for 's' and 't'

Monte Carlo

[B] The acceleration g due to gravity is measured by dropping an object and measuring the time t it takes to travel a distance S. Assuming s and t are normally distributed with means and uncertainties as indicated:

 $s = 2.2 \pm 0.01m$ $t = 0.67 \pm 0.015s$

(i) Estimate (using Monte Carlo simulation with 500 iterations), g and its uncertainty.

g = _____ \pm _____ [Hint: s = $\frac{1}{2}gt^2$]

3. Column statistic for 'g'

Column Statistics		×
	Statistic Sum Sum Sum Standard deviation Minimum Maximum Range Input variable: g	 C Median C Sum of squares C N total C N nonmissing C N missing
	Store result in:	(Optional)
Help		OK Cancel
Column Statistics		×
	Statistic C Sum C Mean G Standard deviation C Minimum C Maximum C Range Input variable: g	 Median Sum of squares N total N nonmissing N missing
	Store result in:	(Optional)

Normal Distribution		X
	Generate 500 rows of data	
	Store in column(s).	
	s	<u> </u>
		-
	Mean: 2.2	
	Standard deviation: 0.01	
Select		
Help	OK Cancel	
Select Help	Mean: 2.2 Standard deviation: 0.01 OK Cancel	*

2. Calculate 'g'

	2*s/						
		t**	2				
							For all a st
	7	8	9	+	-	Δ	All functions
		-	3	-	_	<u> </u>	Absolute value
	4	5	ь	_	<	<u> </u>	Antilog
	1	2	3	*	<=	>=	Arccosine
	0		•	1	A	nd	Arctangent Ceiling
				**	C)r	Cosine Current time
Select				0	N	ot	Select

S	t	g
2.19751	0.666008	9.9084
2.19201	0.665263	9.9057
2.20787	0.691967	9.2222
2.21312	0.670899	9.8338
2.21404	0.677959	9.6340
2.20907	0.692054	9.2248
2.19018	0.669479	9.7732
2.20587	0.670413	9.8158
0.00045	0.004000	0 4700

Mean of g

Mean of g = 9.86910

Standard Deviation of g

Standard deviation of g = 0.469206

Monte Carlo

(ii) Run an Exec file (100 iterations) on the mean value of g. Find the average.Copy the exec file.

1. Store mean of 'g' in k1

Column Statistics				
	Statistic C Sum C Sum Standard deviation C Minimum C Maximum C Range Input variable: g		C Median C Sum of squares C N total C N nonmissing C N missing	
	Store result in:	k1		(Optional)
Select Help			ОК	Cancel

Project manager -> History-> Copy all the scribe



3. Tools-> Notepad-> paste sctibe-> add 'stack k1 C5 C5'



4. Save as 'Prob3B.mtb'. Choose 'All Files'



5. File->Other Files->Run an Exec



6. Indicate trails number and select 'Prob3B.mtb'

Run an Exec		×
Number of times to	execute: 100	
Help	Select File	Cancel

Monte Carlo

 After running the exec file, calculate the mean of C5

Column Statistics				×
K1	Statistic C Sum I Mean C Standard dex C Minimum C Maximum C Range	viation	⊖ Med ⊖ Sum ⊖ N tot ⊖ N no ⊖ N mi	ian of squares al nmissing issing
	Input variable:	C5		
	Store result in:			(Optional)
Select				
Help		Ok		Cancel

Mean of C5

Mean of C5 = 9.81614

Another way to generate data -

bootstrap

[A] Following sample is taken from an unknown population:

 $\{x_i\}$: 10, 19, 22, 13, 9, 16, 12, 24, 17, 23, 18, 14

• Prob 6 in Exam 2

Using an appropriate approach, obtain an estimate of the standard error of the median $\sigma_{\tilde{x}}$.

1. Calc-> Random data-> Sample from column



3. Calc -> column statistics-> Median-> Input variable C2 store k1

rvations	<u>t</u>	
2. Input san	nple number, input co	olumn and output column
Sample From Columns		×
	Sample 12 rows from column(s): C1	
Select	☑ Sample with replacement	
Help	OK Cancel	

olumn Statistics				×	
	Statistic				
	C Sum		Medi	an	
	C Mean		O Sum	of squares	
	O Standard dev	viation –	⊂ N total		
	O Minimum		O N no	nmissing	
	C Maximum		⊖ N mi	ssing	
	C Range				
	Input variable:	C2			
	Store result in:	k1		(Optional)	
Select					
Help			ОК	Cancel	

C1	C2
10	9
19	9
22	18
13	9
9	23
16	24
12	17
24	9
17	12
23	23
18	19
14	18

Bootstrap

4. Project Manager-> History-> Copy

Project Manager	
🚞 Untitled	History
Session	NOTE *** Data window
	Sample 12 C1 c2; Replace
- Graphs	Median C2 k1.
ReportPad	
Related Documents	
🗄 💼 Worksheets	
🗄 💼 Worksheet 1	
- Columns	
🛁 Constants	
Matrices	

5. Paste it in Notepad and add 'stack k1 C5 C5'



6. Save as 'Bootstap.mtb'

File name:	Bootstrap.mtb
Save as type:	All Files

7. Run the exec file 100 times, then Column statistics-> Standard deviation -> Input C5

Column Statistics				×
K1	Statistic Sum Mean Standard dev Minimum Maximum Range Input variable:	viation	○ Med ○ Sum ○ N tot ○ N no ○ N mi	ian of squares al nmissing ssing
	Store result in:			(Optional)
Help		ОК		Cancel

Standard Deviation of C5

Standard deviation of C5 = 1.97215

4. t-test, z-test, power analysis, probability plot

• Problem 2 in Exam 2

We want to test if there is a difference in true average bacteria count (number of colonies/ ft^3) between carpeted (X_i) and uncarpeted (Y_i) rooms. The following samples were taken in a hospital: [Assume Equal Variance 5]

X_i	15.3	16.4	16.2	15.5	15.0	15.3	14.4	15.1	15.6	15.2	16.3
Y_i	13.4	14.8	13.0	14.1	13.7	15.4	16.3	13.2	14.3	15.3	13.9
[Note: $\sum x_i = 170.3$; $\sum y_i = 157.4$]											

(a) State appropriate hypothesis to be tested:

(b) What type of test would you use?

(c) Give values of

Test statistic =

P-value =

s.d. =

(d) Is H₀ rejected or not @ = .05 ?

(e) Give a 95% CI on μ_x - μ_y:

(f) If actually $\mu_x - \mu_y = 1$, how large a sample size would be necessary to test the difference, with a power of .95? (Take $\alpha = .05$)

(g) What main assumption underlies your test? Is the assumption 'justified'?

T-test, z-test	2. Input samples in different columns
Ite Sets of a calc Stat Graph Editor Iools Window Help Image: Setsion Regression ANOVA Stat Graph Editor Iools Window Help Image: Setsion Regression ANOVA Stat Graph Editor Iools Window Help Image: Setsion Regression ANOVA Stat Graph Editor Iools Window Help Image: Setsion Regression ANOVA Stat Graph Editor Iools Window Help Image: Setsion Regression ANOVA Stat Graph Editor Iools Window Help Image: Setsion Regression ANOVA Stat Insertion Quality Tools Time Series Image: Insertion It Insertion Power and Sample Stee P 1 Proportion P 2 Proportions Image: Quarters Image: Quarters and Graphe Stee Image: Quarters and Graphe Stee Image: Quarters and Graphe Stee Image: Quarters and Graphe Stee Image: Quarters and Graphe Stee Image: Quarters and Graphe Stee Image: Quarters and Graphe Stee Image: Quarters and Graphe Stee Image: Quarters and Graphe Stee Image: Quarters and Graphe Stee Image: Quarters and Graphe Stee	2-Sample t (Test and Confidence Interval) C Samples in one column Samples:
Iwo-sample T for x vs y N Mean StDev SE Mean	3. Options-> Confidence level, test difference, Alternative
x 11 15.482 0.611 0.18 y 11 14.31 1.04 0.31	2-Sample t - Options
Difference = mu (x) - mu (y) Estimate for difference: 1.17273 95% CI for difference: (0.41628, 1.92917) There of difference = 0 (we get -); T.Velwe = 2.22, D.Velwe = 2	Test difference: 0.0 Alternative: not equal
Both use Pooled StDev = 0.8505	Help OK Cancel

2 Input samples in different columns

Power analysis

1. Stat-> Power analysis -> 2 sample t test

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) 📽 🖬 📇 🕷	Basic Statistics	· 🔏 🛇 ? 🗃
	Regression	•
(III) Session	ANOVA	•
	Control Charts	•
4/19/2	Quality Tools	•
Worksheet size: 1	Time Series	•
Welcome to Minita	<u>T</u> ables	•
	Nonparametrics	•
Two-Sample T-Te	Power and Sample Size	▶ 1Z 1-Sample <u>Z</u>
Two-sample T for	x vs y	1t 1-Sample t
N N (1)	D 07 M	2t 2-Sample t
v 11 15 492 0	S11 0.19	1P 1 Proportion
x 11 15.462 U.	04 0.31	OD 2 Drepartiens
,		ZF Z Flopordons

2. Input differences and power values, and s.d.

Power and Sample S	ower and Sample Size for 2-Sample t					
Specify values	for any two of the following:					
Sample sizes:						
Differences:	1					
Power values:	0.95					
Standard devia	tion: 0.8505	Options				
Help	ОК	Cancel				

3. Alternative Hypothesis and sig. level

	Power and Sample Size for 2-	Sample t - Options
		Alternative Hypothesis C Less than R Not equal C Greater than
		Significance level: 0.05
1		Store sample sizes in:
/		Store differences in:
		Store power values in:
	Select	
	Help	OK Cancel
	2-Sample t Test Testing mean 1 = Calculating power Alpha = 0.05 Ass	<pre>mean 2 (versus not =) for mean 1 = mean 2 + difference umed standard deviation = 0.8505</pre>
	Sampl Difference Siz	e Target e Power Actual Power
	The sample size i	s for each group.

Probability plot

Graph-> Probability Plot



Probability Plot of y - - -Probability Plot of y Normal - 95% CI 14.31 Mean StDev 1.036 11 95 N 0.744 90 P-Value 0.694 80 70 cent 60 -50 -40 30 20 10 10 11 13 14 15 16 17 18 y

lf pvalue>0.05, it is normal at 95% confidence, otherwise, it is not.

Insert variables

хv

Choose the probability distribution we want to test



5. Control charts

- Devore datasets
- Ex16-08

C1	C2-T
moisture	fabric
12.19999	#1
12.4	#1
12.9	#1
13.2	#1
12.8	#1
13.9	#1
12.2	#1
12.6	#1
14.6	#1
12.8	#1
12.6	#1
13.5	#1
13.4	#1

1. Data-> Unstack Columns



2. Input data and subscripts

Unstack Columns	×
C1 moisture C2 fabric	Unstack the data in: moisture
	Using subscripts in: fabrid
	☐ Include missing as a subscript value
	Store unstacked data:
	In new worksheet
	Name: [Optional]
	C After last column in use
	☑ Name the columns containing the unstacked data
Select	
Help	OK Cancel

+	C1	C1 C2 C3		C4	C5
	moisture_1	moisture_2	moisture_3	moisture_4	moisture_5
1	12.2000	12.1000	13.3000	13.0000	13.0000
2	12.4000	13.3000	12.8000	12.6000	12.9000
3	12.9000	12.7000	14.2000	12.5000	12.9000
4	13.2000	13.0000	13.0000	12.6000	13.9000
5	12.8000	12.3000	12.2000	13.3000	12.0000
6	13.9000	13.4000	13.1000	12.4000	13.2000
7	12.2000	14.4000	12.4000	12.4000	12.5000
8	12.6000	12.8000	13.5000	13.9000	13.1000
9	14.6000	13.4000	12.2000	13.7000	12.5000
10	12.8000	12.3000	12.6000	13.2000	12.8000
11	12.6000	13.1000	12.7000	13.2000	12.3000
12	13.5000	12.3000	12.8000	13.1000	12.9000
13	13.4000	13.3000	12.0000	12.9000	13.1000
14	13.5000	12.4000	13.0000	13.6000	13.4000
15	12.3000	12.8000	13.0000	12.8000	13.5000
16	12.6000	13.4000	12.1000	13.2000	13.3000

Control Chart

Stat-> Control Charts-> Variables charts for subgroups->Xbar/R

<u>S</u>	tat <u>G</u> raph E <u>d</u> itor <u>T</u> ools	<u>Stat</u> <u>Graph</u> E <u>d</u> itor <u>T</u> o	ols <u>M</u>	<u>V</u> indow <u>H</u> elp			
-	Basic Statistics	▶ <u>₩ 0 % ∎</u>		Basic Statistics	•	¥ 🛇 ? 🗗	
11	Regression	•		Regression			
	<u>A</u> NOVA	•		<u>A</u> NOVA	- -)		
	<u>C</u> ontrol Charts	Variables Charts for Subgroups > 🚰 Xbar-R		<u>C</u> ontrol Charts	Þ	Variables Charts for <u>S</u> ubgroups 🕨 🔀 Xbar-R	
1	Quality Tools	Variables Charts for Individuals → Xbar-S		Quality Tools	•	Variables Charts for Individuals 🔸 🔀 Xbar-S.	
	Time <u>S</u> eries	<u>A</u> ttributes Charts		Time <u>S</u> eries	•	Attributes Charts	
	<u>T</u> ables	Time-Weighted Charts		<u>T</u> ables	•	Time-Weighted Charts	
	Nonparametrics	fference R L		Nonparametrics	- 1	× c	
r	Power and Sample Size	0.8505		Power and Sample S	ize 🕨	<u>s 2</u>	

Choose 'Observations for a subgroup are in one row of columns'

Xbar Chart			×
	All observations for a ch All observations for a ch Observations for a subg Subgroup sizes: Scale Multiple Graphs	aart are in one column: aart are in one column: roup are in one row of col (enter a nur Labels Data Options	umns:
Select			-
Help		ОК	Cancel



Input all the columns

Xb	ar Chart			
	21 moisture_1 22 moisture_2 33 moisture_3 44 moisture_4 25 moisture_5	Observations for a subg 'moisture_1''moisture_ 'moisture_5' Scale Multiple Graphs	roup are in one row of co _2" 'moisture_3" 'moistur 	olumns: e_4' Xbar Options
	Select			
	Help		<u> </u>	Cancel

Control chart

• Perform eight tests:

Choose Xbar Options



Test-> 'Perform all tests for special causes'

Xbar Chart - Options							
Parameters Estimate S Limits Tests Stages Display Storage							
Perform all tests for special causes							
1 point > 3 standard deviations from center line							
9 points in a row on same side of center line							
6 points in a row, all increasing or all decreasing							
14 points in a row, alternating up and down							
\square 2 out of 3 points > 2 standard deviations from center line (same side)							
\square 4 out of 5 points > 1 standard deviation from center line (same side)							
15 points in a row within 1 standard deviation of center line (either side)							
■ 8 points in a row > 1 standard deviation from center line (either side)							
Help OK Cancel							

6. Scatter plot, regression

- MINITAB worksheet TREES
- (a) Obtain the scatter plot of the data(volume vs. diameter and volume vs. height)

Graph-> Scatterplot	Scatterplot - Simple	Scatterplot - Simple
MINITAB Student - Unitited Fle Edit Data Calc Stat Graph Editor Iools Window Image: Session Image: Marginal Plot Image: State Plot Image: Marginal Plot Image: State Plot Image: Marginal Plot Image: State Plot	C1 Diameter C2 Height C3 Volume 2 3 3 - 4 - 5 - 6 - 7 - Scale Labels Multiple Graphs Data Options	C1 Diameter C2 Height C3 Volume 2 - 3 - 4 - 5 - 6 - 7 - Scale Labels Multiple Graphs Data Options
Probability Plot of y		Scatterplot of Volume ur. Heinht
Results for: Workshee Ple Chart Xbar Chart of moisture Ime Series Plot Image: A provide the series of the series plot Image: A provide the series plot	Scatterplot of Volume vs Diameter	Scatterplot of Volume vs Height
Scatterplots	70- 60- 50- 40- 30-	70- 60- 50- 9 40- 30-

Regression

 (b) Use diameter as a predictor of volume, do a least square analysis and obtain simple linear **Regression Analysis: Volume versus Diameter** parameter

Stat-> Regression-> Regression

Basic Statistics Image: Control Charts Image: Control Charts Image: Control Charts Quality Tools Image: Control Charts Image: Control Charts Time Series Image: Control Charts Tables Image: Control Charts Best Subsets Quality Tools Image: Control Charts	<u>Stat</u> Graph Editor Tools	Window Help
Regression Image: Regression ANOVA Image: Subsets Control Charts Image: Subsets Quality Tools Image: Subsets Time Series Image: Subsets Tables Image: Subsets Nonparametrics Image: Subsets Power and Sample Size Image: Subsets	Basic Statistics	
ANOVA Service And	<u>R</u> egression	Regression
Control Charts Image: Best Subsets Qualty Tools Image: Binary Logistic Regression Time Series Image: Binary Logistic Regression Jables Bonarametrics Bower and Sample Size Image: Binary Logistic Regression	<u>A</u> NOVA	• <u>£</u> Stepwise
Quality Tools Time Series Tables Nonparametrics Power and Sample Size	Control Charts	• 🚮 Best Subsets
Time Series Tables <u>N</u> onparametrics <u>P</u> ower and Sample Size	Quality Tools	Fitted Line Plot
Tables	Time <u>S</u> eries	Binary Logistic Regression
Nonparametrics Power and Sample Size	<u>T</u> ables	Bindify Edgication in
Power and Sample Size	Nonparametrics	•
	Power and Sample Size	•

The regression equation is Volume = - 36.9 + 5.07 Diameter

Predictor	Coef	SE Coef	Т	P
Constant	-36.943	3.365	-10.98	0.000
Diameter	5.0659	0.2474	20.48	0.000

S = 4.25199 R-Sq = 93.5% R-Sq(adj) = 93.3%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	7581.8	7581.8	419.36	0.000
Residual Error	29	524.3	18.1		
Total	30	8106.1			

Unusual Observations

Obs	Diameter	Volume	Fit	SE Fit	Residual	St Resid
31	20.6	77.000	67.413	1.972	9.587	2.55RX

R denotes an observation with a large standardized residual. X denotes an observation whose X value gives it large influence.

Input Volume and Diameter

Regression			×
	Response: Predictors:	Volume	*
Select		Graphs Results	Options Storage
Help		ОК	Cancel