

## Chapter 10

### Descriptive Analysis and Hypothesis Testing (2 Variables)

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- Descriptive analysis is an analysis conducted to assess the characteristics of a data. There are many characteristics, including:
  - Mean
  - Standard Error
  - Median
  - Mode
  - Standard Deviation
  - Sample Variance
  - Kurtosis
  - Skewness
  - Range
  - Minimum
  - Maximum
  - Sum
  - Count
  - Largest(1)
  - Smallest(1)

- Example, Descriptive Analysis (1)

<b>Grading</b>
78
90
87
98
99
87
78
85
81
72
85
74
77
82
94

- Answer, Descriptive Analysis (1)

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<i>Grading</i>	
Mean	84,4666667
Standard Error	2,12886437
Median	85
Mode	78
Standard Deviation	8,24505624
Sample Variance	67,9809524
Kurtosis	-0,6689813
Skewness	0,37040394
Range	27
Minimum	72
Maximum	99
Sum	1267
Count	15
Largest(1)	99
Smallest(1)	72

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- Example, Descriptive (2)

CLASS A	CLASS B
78	81
90	72
87	87
98	87
99	78
87	90
78	87
85	98
81	72
72	85
85	74
74	77
77	82
82	78
94	85

- Answer, Descriptive (2)

CLASS A		CLASS B	
Mean	84,4666667	Mean	82,2
Standard Error	2,12886437	Standard Error	1,87006493
Median	85	Median	82
Mode	78	Mode	87
Standard Deviation	8,24505624	Standard Deviation	7,24273035
Sample Variance	67,9809524	Sample Variance	52,4571429
Kurtosis	-0,6689813	Kurtosis	0,03504022
Skewness	0,37040394	Skewness	0,39702784
Range	27	Range	26
Minimum	72	Minimum	72
Maximum	99	Maximum	98
Sum	1267	Sum	1233
Count	15	Count	15
Largest(1)	99	Largest(1)	98
Smallest(1)	72	Smallest(1)	72

- T-tests are hypothesis tests that assess the means of one or two groups. Hypothesis tests use sample data to infer properties of entire populations. To be able to use a t-test, you need to obtain a random sample from your target populations. Depending on the t-test and how you configure it, the test can determine whether:
  - Two group means are different.
  - Paired means are different.
  - One mean is different from a target value.
- Example, t-test: paired two sample for means (1)

<b>Before</b>	<b>After</b>
78	81
90	72
87	87
98	87
99	78
87	90
78	87
85	98
81	72
72	85
85	74
74	77
77	82
82	78
94	85

- Answer, t-test: paired two sample for means (1)

	<i>Before</i>	<i>After</i>
Mean	84,4666667	82,2
Variance	67,9809524	52,4571429
Observations	15	15
Pearson Correlation	0,06411222	
Hypothesized Mean Difference	0	
df	14	
t Stat	0,82663808	
P(T<=t) one-tail	0,2111539	
t Critical one-tail	1,76131014	
P(T<=t) two-tail	0,42230779	
t Critical two-tail	2,14478669	

- Example, t-test: paired two sample for means (2)

<b>Before</b>	<b>After</b>
23	26
41	31
32	18
45	36
22	42
33	34
21	23
34	41
45	32
19	23
49	37
27	36
26	22
31	33
18	21
32	34
37	41
36	32
42	33
34	21

- Answer, t-test: paired two sample for means (2)

	<i>Before</i>	<i>After</i>
Mean	32,35	30,8
Variance	83,3973684	54,5894737
Observations	20	20
Pearson Correlation	0,430893	
Hypothesized Mean Difference	0	
df	19	
t Stat	0,77577872	
P(T<=t) one-tail	0,22371455	
t Critical one-tail	1,72913281	
P(T<=t) two-tail	0,44742909	
t Critical two-tail	2,09302405	

- Example, t-test: two sample assuming equal variances (1)

<b>Grade 1</b>	<b>Grade 2</b>
78	81
90	72
87	87
98	87
99	78
87	90
78	87
85	98
81	72
72	85
85	74
74	77
77	82
82	78
94	85

- Answer, t-test: two sample assuming equal variances (1)

	<i>Grade 1</i>	<i>Grade 2</i>
Mean	84,46666667	82,2
Variance	67,98095238	52,4571429
Observations	15	15
Pooled Variance	60,21904762	
Hypothesized Mean Difference	0	
df	28	
t Stat	0,799928828	
P(T<=t) one-tail	0,215243369	
t Critical one-tail	1,701130934	
P(T<=t) two-tail	0,430486738	
t Critical two-tail	2,048407142	

- Example, t-test: two sample assuming equal variances (2)

<b>Grade 1</b>	<b>Grade 2</b>
23	26
41	31
32	18
45	36
22	42
33	34
21	23
34	41
45	32
19	23
49	37
27	36
26	22
31	33
18	21
32	34
37	41
36	32
42	33
34	21

- Answer, t-test: two sample assuming equal variances (2)

	<i>Grade 1</i>	<i>Grade 2</i>
Mean	32,35	30,8
Variance	83,39736842	54,5894737
Observations	20	20
Pooled Variance	68,99342105	
Hypothesized Mean Difference	0	
df	38	
t Stat	0,590103048	
P(T<=t) one-tail	0,279307296	
t Critical one-tail	1,68595446	
P(T<=t) two-tail	0,558614592	
t Critical two-tail	2,024394164	

- Example, t-test: two sample assuming unequal variances (1)

<b>School A</b>	<b>School B</b>
78	81
90	72
87	87
98	87
99	78
87	90
78	87
85	98
81	72
72	85
85	74
74	77
77	82
82	78
94	85

- Answer, t-test: two sample assuming unequal variances (1)

	<i>School A</i>	<i>School B</i>
Mean	84,4666667	82,2
Variance	67,9809524	52,4571429
Observations	15	15
Hypothesized Mean Difference	0	
df	28	
t Stat	0,79992883	
P(T<=t) one-tail	0,21524337	
t Critical one-tail	1,70113093	
P(T<=t) two-tail	0,43048674	
t Critical two-tail	2,04840714	

- Example, t-test: two sample assuming unequal variances (2)

<b>School A</b>	<b>School B</b>
23	26
41	31
32	18
45	36
22	42
33	34
21	23
34	41
45	32
19	23
49	37
27	36
26	22
31	33
18	21
32	34
37	41
36	32
42	33
34	21

- Answer, t-test: two sample assuming unequal variances (2)

	<i>School A</i>	<i>School B</i>
Mean	32,35	30,8
Variance	83,3973684	54,5894737
Observations	20	20
Hypothesized Mean Difference	0	
df	36	
t Stat	0,59010305	
P(T<=t) one-tail	0,27940385	
t Critical one-tail	1,68829771	
P(T<=t) two-tail	0,5588077	
t Critical two-tail	2,028094	