

## Section 7.2: Confidence Intervals for Population Means with an unknown Standard Deviation

If we use a sample to make an inference about a population mean then we must not know what the population mean is. If we don't know the population mean then it seems quite unlikely that we know the population standard deviation. So we make two changes to our approach for constructing a confidence interval for the mean. The first change is simple. Use the sample standard deviation as an estimate for the population standard deviation. When using this estimation, we are no longer guaranteed a normal distribution. The second change is using the **Student's  $t$  Distribution** in place of the Normal Distribution. The final form for our confidence interval for the mean with an unknown  $\sigma$  is

$$\bar{x} \pm \text{margin of error} = \bar{x} \pm t_{\frac{\alpha}{2}} \times \frac{s}{\sqrt{n}}$$

where  $t_{\frac{\alpha}{2}}$  is a function of the level of confidence and the number of degrees of freedom =  $n - 1$ .

**Remark 1** *A confidence interval for the mean with unknown population standard deviation is computed on the TI-83/84 using the **TInterval** command from statistical tests.*

**Example 1** *A sample of size  $n = 19$  yields a sample mean of 76.3 and sample standard deviation of 8.1. Construct a 95% confidence interval for the mean. Since the population standard deviation is unknown we use the student  $t$  distribution. On the calculator select **STATS** as your option and then **TInterval(76.3, 8.1, 19, .95) = (72.396, 80.204)**.*

**Exercise 1** *A sample of size  $n = 39$  yields a sample mean of 76.3 and sample standard deviation of 8.1. Construct a 95% confidence interval for the mean. Compare your result to the prior example.*

**Exercise 2** *A random sample of 57 KSU students yields a sample average driving distance from home to campus of 7.8 miles with a sample standard deviation of 4.5 miles. Construct a 99% confidence interval for the average number of miles KSU students drive to campus.*

**Example 2** In the first 6 games of the 2017 season, Atlanta Falcons quarterback, Matt Ryan, has thrown for total game yards of 321, 252, 294, 242, 248 and 233. Construct a 99% confidence interval for the average number of yards per game Ryan will throw for in 2017.

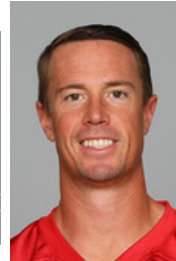
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Date	Week Tm	Opp Result	GS	Passing										Rushing				
				Cmp	Att	Cmp%	Yds	TD	Int	Rate	Sk	Yds	Y/A	AY/A	Rush	Yds	Y/A	TD
2017-09-10	1	ATL @ CHI W 23-17	*	21	30	70.00	321	1	0	116.1	2	13	10.70	11.37	3	11	3.67	0
2017-09-17	2	ATL @ GNB W 34-23	*	19	28	67.86	252	1	0	108.0	3	29	9.00	9.71	1	8	8.00	0
2017-09-24	3	ATL @ DET W 30-26	*	24	35	68.57	294	2	3	77.6	2	17	8.40	5.69	1	-1	-1.00	0
2017-10-01	4	ATL @ BUF L 17-23	*	24	42	57.14	242	1	2	61.8	1	0	5.76	4.10	1	8	8.00	0
2017-10-15	6	ATL @ MIA L 17-20	*	24	35	68.57	248	1	1	86.4	2	9	7.09	6.37	0	0	0	0
2017-10-22	7	ATL @ NYE L 7-23	*	23	33	69.70	233	1	0	99.7	1	10	7.06	7.67	3	37	12.33	0

**Upcoming Games - Bye in Week 5**

2017-10-29	8	ATL @ NYJ	<a href="#">Preview</a> - <a href="#">Stats for 2 games vs. Jets</a> - Avg. 26/40, 236 yds, 1.5 TD, 0.0 int (Last in 2013)
2017-11-05	9	ATL @ CAS	<a href="#">Preview</a> - <a href="#">Stats for 18 games vs. Panthers</a> - Avg. 24/36, 270 yds, 1.6 TD, 0.8 int (Last in 2016)
2017-11-12	10	ATL @ DAL	<a href="#">Preview</a> - <a href="#">Stats for 3 games vs. Cowboys</a> - Avg. 22/35, 275 yds, 1.3 TD, 0.7 int (Last in 2015)

[Falcons 2017 Stats and Schedule](#) - [Matt Ryan Spitz](#) - [Matt Ryan Gamelous](#) - [TD Passes](#) - [Game-Winning Drives](#) - [Penalties](#)



On the calculator enter the sample into list  $L_1$  and then select DATA as your option in TInterval. The resulting confidence interval is (208.03, 321.97).

**Exercise 3** Dr. Jones grades eight papers from his introduction to archeology course. The scores are 91, 73, 78, 92, 84, 77, 71 and 98. Construct a 90% confidence interval for the mean population grade for this test.

## 1 Exercises

1. Navidi/Monk: Section 7.3: 17-24, 31, 32