Statistics in a Nutshell

Any discussion of statistical tools and their proper use depends on at least some language in common and a certain degree of mutual understanding of certain concepts between the conversants. The intent of this chapter is to review or introduce core principles and concepts ("Statistics in a Nutshell") and a slightly more advanced, but still central topic, "Power and Sample Size Concepts and Calculations."

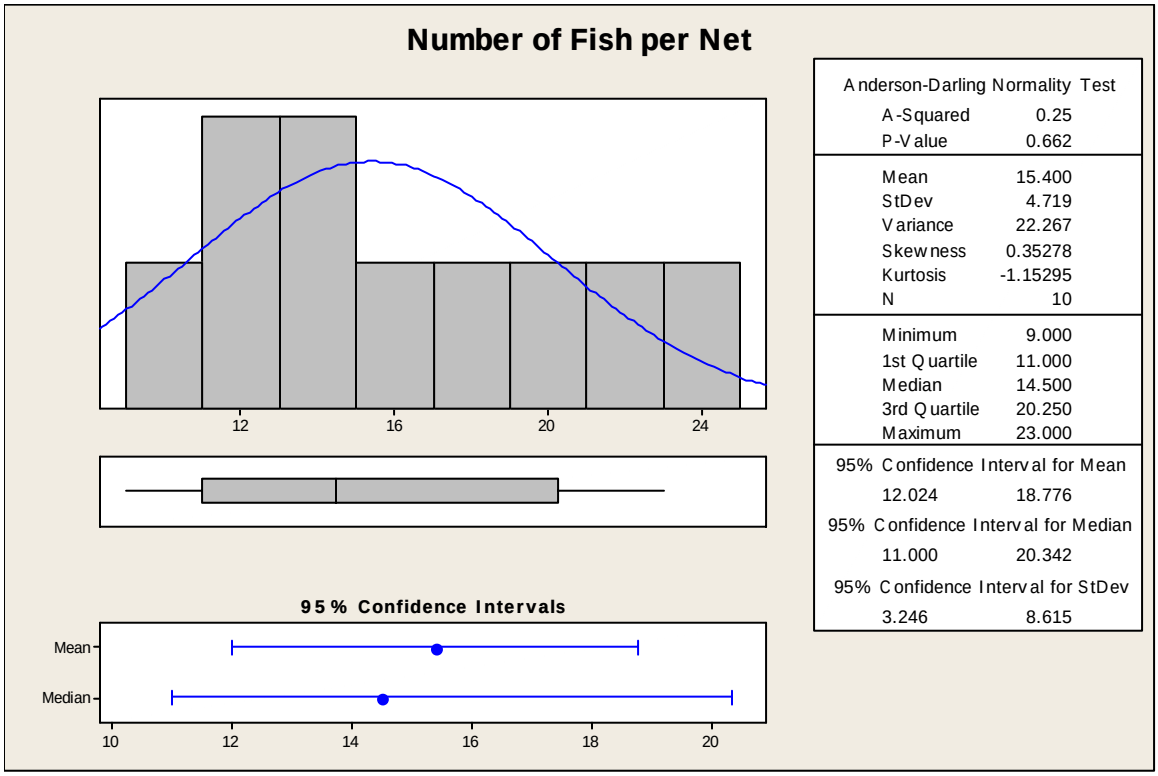
In this chapter, I will show you a routine analysis of a simple data set; to do so I will need explicitly or implicitly to use many of the core principles and concepts that underly statistical inference. As you read through the example, you'll see links and buttons that explore those ideas. Click as you wish.

Fish Stocking: Spring or Fall?

As an experiment, fish-stocking in Alcova Reservoir was done in the fall of 1996 instead of the traditional spring period. The intent was to see if the change of timing resulted in an increase in the fish population for that reservoir.

In the summer of 1997, ten nets were set on Alcova Reservoir by Wyoming Game and Fish biologists as part of their monitoring of the local trout population. The net locations were chosen judiciously by the biologists to ensure adequate spatial coverage of the reservoir and to avoid locations where their experience suggested that they would catch no or very few fish.

The number of fish caught per net was: 14, 23, 11, 20, 11, 21, 17, 15, 9, and 13. The mean number per net was 15.4, with a standard deviation of 4.72. Here is a summary of the data:



Anderson-Darling Normality Test	
A-Squared	0.25
P-Value	0.662
Mean	15.400
StDev	4.719
Variance	22.267
Skewness	0.35278
Kurtosis	-1.15295
N	10
Minimum	9.000
1st Quartile	11.000
Median	14.500
3rd Quartile	20.250
Maximum	23.000
95% Confidence Interval for Mean	
12.024	18.776
95% Confidence Interval for Median	
11.000	20.342
95% Confidence Interval for StDev	
3.246	8.615

A 95% confidence interval  on the mean is (12.0, 18.8). Historical records showed an average of 12 fish per net. As a test to see if recent management changes were improving the fishery, the biologists performed a hypothesis test  for an increase (i.e. a one-tailed test). The new method didn't entail any particularly large costs, so the consequences of a false significance were low; they chose an alpha-level of 0.10. The test yielded a *p*-value of 0.024, suggesting that there was good evidence (against an alpha of 0.10) in support of their management change. A 95% lower confidence bound on the mean was 12.66.

For their tests and intervals to be valid, the biologists have to assume that their non-random sample (they wisely did *not* randomly select netting locations in the lake) of net-sets was representative of the larger population of net-sets. They need to assume their data are mutually independent: that the number of fish collected in one net has nothing to do with the number in other nets. These validity conditions are not met, strictly speaking, so the biologists need to hope that their results are not badly affected by those problems. I note that this situation is not a failure on the part of the fisheries biologists; simply, it is something they cannot do too much about.

They also need to assume that the sampling distribution of the mean is approximately Normal for validity of their tests  .