

Business Analytics

Chapter 6 Statistical Inference



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Statistical Inference

If we want to know something about a population, why can't we just ask everyone?

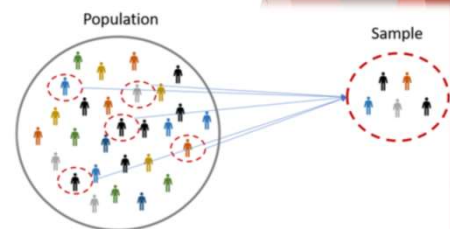
- ▶ We can:
 - ▶ With - A Census
 - ▶ collects data from every element in the population of interest
- ▶ We can't always ask everyone though:
 - ▶ Expensive.
 - ▶ Time consuming.
 - ▶ Misleading.
 - ▶ Unnecessary.
 - ▶ Impractical.



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Statistical Inference

- ▶ **Statistical inference**
 - ▶ Uses sample data to make estimates of or draw conclusions about one or more characteristics of a population.
- ▶ **The sampled population**
 - ▶ is the population from which the sample is drawn.
- ▶ **A frame**
 - ▶ is a list of elements from which the sample will be selected.



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Sampling Examples

- ▶ **Election Year!**
 - ▶ Texas members of a political party are considering supporting a candidate
 - ▶ Need to estimate the proportion of voters that favor the candidate in Texas
 - ▶ Of 400 voters, 160 prefer the candidate = 40%
- ▶ **New Tires**
 - ▶ Tire company makes a new tire that is supposed to have increased life on the roads
 - ▶ Makes 120 tires for testing
 - ▶ Mean of 36,500 miles



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Selecting a Sample

Sampling from a Finite Population

Sampling from an Infinite Population

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Selecting a Sample

- ▶ **Parameter:**

- ▶ A measurable factor that defines a characteristic of a population, process, or system.

- ▶ Examples: Population: Mean, Standard Deviation, Correlation, Variance

- ▶ **Sampling from a Finite Population:**

- ▶ make valid statistical inferences about the population.

- ▶ **Simple Random Sample (Finite Population):**

- ▶ A **simple random sample** of size n from a finite population of size N

- ▶ is a sample selected such that each possible sample of size n has the same probability of being selected.

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Selecting a Sample

Figure 6.1: Using Excel to Select a Simple Random Sample

	A	B	C	D	E	F	G		A	B	C	D
	Employee	Annual Salary	Training Program	Random Numbers					Employee	Annual Salary	Training Program	Random Numbers
1	1	75769.50	No	0.613872				1	812	69094.30	Yes	0.000193
2	2	70821.00	Yes	0.473304				2	1411	73263.90	Yes	0.000484
3	3	68408.20	No	0.549111				3	1795	69643.50	Yes	0.002641
4	4	69787.50	No	0.047482				4	2095	69894.90	Yes	0.002763
5	5	72801.60	Yes	0.531185				5	1235	67621.60	No	0.002940
6	6	71767.70	No	0.994296				6	744	75924.00	Yes	0.002977
7	7	78346.60	Yes	0.189065				7	470	69092.30	Yes	0.003182
8	8	66670.20	No	0.020714				8	1606	71404.40	Yes	0.003448
9	9	70246.80	Yes	0.647318				9	1744	70957.70	Yes	0.004203
10	10	71255.00	No	0.524341				10	179	75109.70	Yes	0.005293
11	11	72546.60	No	0.764998				11	1387	65922.60	Yes	0.005709
12	12	69512.50	Yes	0.255244				12	1782	77268.40	No	0.005729
13	13	71753.00	Yes	0.010923				13	1006	75688.80	Yes	0.005796
14	14	73547.10	No	0.238003				14	278	71564.70	No	0.005966
15	15	68052.20	No	0.635675				15	1850	76188.20	No	0.006250
16	16	64652.50	Yes	0.177294				16	844	71766.00	Yes	0.006708
17	17	71764.00	Yes	0.435097				17	2028	72541.30	No	0.007767
18	18	65187.80	Yes	0.883440				18	1654	64980.00	Yes	0.008095
19	19	69867.50	Yes	0.476324				19	444	71932.60	Yes	0.009686
20	20	71706.30	Yes	0.101965				20	556	72973.00	Yes	0.009711
21	21	72039.50	Yes	0.775323				21	2449	65120.90	Yes	0.010595
22	22	72977.60	No	0.011729				22	13	71753.00	Yes	0.010923
23	23	71372.50	No	0.762026				23	2187	74391.80	No	0.011364
24	24	74592.00	Yes	0.066344				24	1633	70164.20	No	0.011603
25	25	75738.10	Yes	0.776766				25	22	72973.60	No	0.011729
26	26	72975.10	Yes	0.828493				26	1530	70241.30	No	0.013570
27	27	72366.20	Yes	0.841532				27	820	72793.90	No	0.013669
28	28	71051.60	Yes	0.899427				28	1258	70979.40	Yes	0.014042
29	29	72095.60	Yes	0.486284				29	2349	75860.90	Yes	0.014532
30	30	64956.50	No	0.264628				30	1698	77309.10	No	0.014539
31								31				
32								32				

Note: Rows 32–2501 are not shown.

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Selecting a Sample

► Sampling from an Infinite Population:

- With an infinite population, you cannot select a simple random sample because you cannot construct a frame consisting of all the elements.
- Statisticians recommend selecting what is called a random sample.
- Usually associated with a process that operates over time.
 - An ongoing process

► Random Sample (Infinite Population):

- A **random sample** of size n from an infinite population is a sample selected such that the following conditions are satisfied:
 1. Each element selected comes from the same population.
 2. Each element is selected independently.

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Point Estimation

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Point Estimation

► Sample statistic

- An estimate for a population parameter

	Population	Sample
Mean	μ	\bar{x}
Standard Deviation	σ	s
Proportion	p	\bar{p}

The sample mean \bar{x} is the **point estimator** of the population mean μ

The sample standard deviation s is the **point estimator** of the population standard deviation σ .

The sample proportion \bar{p} is the **point estimator** of the population proportion p .

The numerical value obtained for \bar{x} , s , or \bar{p} is called the **point estimate**.

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Point Estimation

Annual Salary and Training Program
Status for a Simple Random Sample of
30 EAI Employees (Excel)

Annual Salary (\$)	Management Training Program	Annual Salary (\$)	Management Training Program
$x_1 = 69,094.30$	Yes	$x_{16} = 71,766.00$	Yes
$x_2 = 73,263.90$	Yes	$x_{17} = 72,541.30$	No
$x_3 = 69,343.50$	Yes	$x_{18} = 64,980.00$	Yes
$x_4 = 69,894.90$	Yes	$x_{19} = 71,932.60$	Yes
$x_5 = 67,621.60$	No	$x_{20} = 72,973.00$	Yes
$x_6 = 75,924.00$	Yes	$x_{21} = 65,120.90$	Yes
$x_7 = 69,092.30$	Yes	$x_{22} = 71,753.00$	Yes
$x_8 = 71,404.40$	Yes	$x_{23} = 74,391.80$	No
$x_9 = 70,957.70$	Yes	$x_{24} = 70,164.20$	No
$x_{10} = 75,109.70$	Yes	$x_{25} = 72,973.60$	No
$x_{11} = 65,922.60$	Yes	$x_{26} = 70,241.30$	No
$x_{12} = 77,268.40$	No	$x_{27} = 72,793.90$	No
$x_{13} = 75,688.80$	Yes	$x_{28} = 70,979.40$	Yes
$x_{14} = 71,564.70$	No	$x_{29} = 75,860.90$	Yes
$x_{15} = 76,188.20$	No	$x_{30} = 77,309.10$	No