

ECE 341 - Homework #12

t-Test with a Single Population

Reaction Time

1) Go to the Human Benchmark Dashboard and record your reaction times.

<https://humanbenchmark.com/tests/reactiontime>

From your results

- What is the 90% confidence interval for your reaction time each game?
- What is the 90% confidence interval for your average reaction time?

First, collect some data. Running the experiment five times:

```
>> Data = [218, 198, 215, 195, 205]

Data =    218    198    215    195    205
```

Find the mean and standard deviation

```
>> x = mean(Data)
x =    206.2000

>> s = std(Data)
s =    10.1341
```

From a t-table with 4 degrees of freedom (sample size 5), the t-score for 5% tails is 2.13185

For each game, the 90% confidence interval is (184.59ms, 227.80ms)

```
>> x - 2.13185*s
ans =    184.5956

>> x + 2.13185*s
ans =    227.8044
```

My average reaction time has a 90% confidence interval of (196.52ms, 215.86ms)

```
>> x - 2.13185*s/sqrt(5)
ans =    196.5382

>> x + 2.13185*s/sqrt(5)
ans =    215.8618
```

2) What is the probability that your reaction time will be less than 200ms

- For the next trial?
- For your overall average reaction time?

Next Trial

Find the t-score

$$>> t = (x - 200) / s$$

$$t = 0.6118$$

Convert to a probability using a t-table with 4 dof (or StatTrek)

- $p = 0.285858$
- There is a 28.5% chance of any given trial being faster than 200ms

- Select the statistic and probability.
- Enter a value for degrees of freedom.
- Enter a value in one of the remaining textboxes.
- Click Calculate to fill in the empty textbox.

Statistic	t-score	▼
Probability	P(T ≤ t)	▼
Degrees of freedom	4	
t-score	-0.6118	
P(T ≤ -0.6118)	0.286868	

Calculate

Overall average

Find the t-score (population question)

```
>> t = (x - 200) / ( s/sqrt(5) )
```

```
t = 1.3680
```

Convert to a probability using a t-table with 4 dof (or StatTrek)

- $p = 0.121476$
- There is a 12.1% chance my overall average reaction time is faster than 200ms

- Select the statistic and probability.
- Enter a value for degrees of freedom.
- Enter a value in one of the remaining textboxes.
- Click Calculate to fill in the empty textbox.

Statistic	t-score
Probability	$P(T \leq t)$
Degrees of freedom	4
t-score	-1.3686
$P(T \leq -1.3686)$	0.121476

Calculate

Aim Trainer

3) Go to the Human Benchmark Dashboard. Record your time to hit 30 targets

<https://humanbenchmark.com/tests/aim>

From your results

- What is the 90% confidence interval for your time each game?
- What is the 90% confidence interval for your average time?

Start by collecting data

```
>> Data = [630, 602, 586]

Data =    630    602    586
```

Find the mean and standard deviation

```
>> x = mean(Data)

x =    606

>> s = std(Data)

s =    22.2711
```

From StatTrek, 5% tails with 2 degrees of freedom corresponds to a t-score of 2.91999. The 90% confidence interval for any given game is (540ms, 671ms)

```
>> x + s*2.91999

ans =    671.0313

>> x - s*2.91999

ans =    540.9687
```

The 90% confidence interval for my overall average time is (568ms, 643ms)

```
>> x + s*2.91999/sqrt(3)

ans =    643.5458

>> x - s*2.91999/sqrt(3)

ans =    568.4542
```

7-Card Poker

The results from a Monte Carlo simulation of 100,000 hands of 7-card poker are:

- Deal 7 cards to each player, take the best 5-card hand

Hand	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Straight Flush	224	219	215	227	202
Four of a Kind	169	157	170	162	167
Full House	2,548	2,641	2,567	2,485	2,585
Flush	2,760	2,812	2,774	2,805	2,860
Straight	5,166	4,992	5,084	5,118	5,083
3 of a Kind	4,766	4,829	4,824	4,730	4,763
2 Pair	23,564	23,422	23,502	23,446	23,684
Pair	43,778	43,719	43,688	43,883	43,563
High Card	17,025	17,209	17,176	17,144	17,093

4) From these results for a 4-of-a-kind

- What is the 90% confidence interval for the number of hands that will be 4-of-a-kind in 100,000 hands?
- What is the 90% confidence interval for the odds of getting 4-of-a-kind (population question)

Start with the data for 4-of-a-kind:

```
>> Data = [169 157 170 162 167];
```

Find the mean and standard deviation

```
>> x = mean(Data)
x = 165

>> s = std(Data)
s = 5.4314
```

From StatTrek the t-score for 5% tails and 4 dof is 2.13185. The 90% confidence interval for the number of 4ok hand in 100,000 hands of poker is (153.4, 176.6)

```
>> x + 2.13185*s
ans = 176.5789

>> x - 2.13185*s
ans = 153.4211
```

The 90% confidence interval for the actual odds of getting 4ok in 100,000 hands is (159.82, 170.18)

- Exact odds: 168.1 from homework #3)

```
>> x + 2.13185*s/sqrt(5)
ans = 170.1782

>> x - 2.13185*s/sqrt(5)
ans = 159.8218
```

5) From these results for a full house:

- What is the 90% confidence interval for the number of hands that will be a full=house?
- What is the 90% confidence interval for the odds of getting a full house?

Start with the data:

```
>> Data = [2548 2641 2567 2485 2585];
```

Find the mean and standard deviation

```
>> x = mean(Data)
```

```
x = 2.5652e+003
```

```
>> s = std(Data)
```

```
s = 56.7204
```

For any given Monte-Carlo run, the 90% confidence interval for the number of full-houses is (2444, 2686)

```
>> x + 2.13185*s  
ans = 2.6861e+003
```

```
>> x - 2.13185*s  
ans = 2.4443e+003
```

The actual odds of getting a full-house in 7-card stud in in the range of (2511, 2619) with 90% certainty

- exact odds: 2596.1 from homework #2

```
>> x + 2.13185*s/sqrt(5)  
ans = 2.6193e+003
```

```
>> x - 2.13185*s/sqrt(5)  
ans = 2.5111e+003
```

6) From these results for a flush:

- What is the 90% confidence interval for the number of hands that will be a flush?
- What is the 90% confidence interval for the odds of getting a flush?

note: Exact odds were computed in homework set #2 and #3

Start with the raw data

```
>> Data = [2760 2812 2774 2805 2860];
```

Find the mean and standard deviation

```
>> x = mean(Data)
x = 2.8022e+003
```

```
>> s = std(Data)
s = 38.7969
```

For a given Monte-Carlo run of 100,000 hands, the number of flushes is in the range of (2719, 2884)

```
>> x + 2.13185*s
ans = 2.8849e+003
```

```
>> x - 2.13185*s
ans = 2.7195e+003
```

The actual odds of getting a flush in 7-card stud is in the range of (2765, 2839) with 90% certainty

```
>> x + 2.13185*s/sqrt(5)
ans = 2.8392e+003
```

```
>> x - 2.13185*s/sqrt(5)
ans = 2.7652e+003
```

```
>>
```

Exact odds 3056.6 from homework #2

- Either calculations in homework #2 had a mistake, or
- The Monte-Carlo simulation in homework #1 had a mistake