

ECE 341 - Homework #13

t-Tests with Two Populations

Reaction Time

1) Go to the Human Benchmark Dashboard and record your reaction times or the times of someone else.

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

Let

- Population A: Your times from homework set #12
- Population B: Reaction times just recorded

What is the probability

- A's time is less than B's time for the next trial?
- A's overall reaction time is less than B's (population question)

Step 1: Collect data

```
>> A = [218, 198, 215, 195, 205]
>> B = [196, 201, 207, 193, 195];
```

Individual: Create a new variable, $W = A - B$

```
>> Xw = mean(A) - mean(B)
Xw = 7.8000
```

```
>> Vw = var(A) + var(B);
>> Sw = sqrt(Vw)
Sw = 11.5974
```

```
>> t = Xw / Sw
t = 0.6726
```

From StatTrek, this corresponds to a probability of 0.7300%

A will have a slower reaction time than B next trial with 73% certainty

Population:

```
>> Vw = var(A)/5 + var(B)/5;
>> Sw = sqrt(Vw)
```

```
Sw = 5.1865
```

```
>> t = Xw / Sw
```

```
t = 1.5039
```

From StatTrek, this corresponds to a probability of 89.6%

A's average reaction time is slower than B's with 89.6% certainty

- 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

Probability

Degrees of freedom

t-score

P(T ≤ 0.6726)

Calculate

- 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

Probability

Degrees of freedom

t-score

P(T ≤ 1.5039)

Calculate

Aim Trainer

2) Go to the Human Benchmark Dashboard. Record your time (or someone else's time) to hit 30 targets

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

Let

- Population A: Your times from homework set #12
- Population B: Reaction times just recorded

What is the probability

- A's time is less than B's time for the next trial?
- A's overall reaction time is less than B's (population question)

Collect Data

```
>> A = [630, 602, 586];  
>> B = [557, 555];
```

Individual: Create a new variable: $W = A - B$

```
>> Xw = mean(A) - mean(B)  
Xw = 50
```

```
>> Vw = var(A) + var(B);  
>> Sw = sqrt(Vw)  
Sw = 22.3159
```

```
>> t = Xw / Sw  
t = 2.2406
```

From StatTrek, this corresponds to a probability of 86.6%

The next time the game is played, A will have a larger reaction time than B with 86.6% certainty

Population:

```
>> Vw = var(A) / 3 + var(B) / 2;  
>> Sw = sqrt(Vw)
```

```
Sw = 12.8970
```

```
>> t = Xw / Sw
```

```
t = 3.8769
```

A's average reaction time is longer than B's with 91.9% certainty

- 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

Probability

Degrees of freedom

t-score

P(T ≤ 2.2406)

Calculate

- 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

Probability

Degrees of freedom

t-score

P(T ≤ 3.8796)

Calculate

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

3) From the results, it *looks* like it's easier to get a straight flush than a 4-of-a-kind

- What is the probability that you'll get more straight-flushes than 4-of-a-kind hands next time you deal out 100,000 hands?
- What is the probability that it actually *is* more likely to be dealt a straight flush than 4-of-a-kind in 7-card poker?

Let

- Population A be straight-flushes
- Population B be 4-of-a-kind

```
>> A = [224    219    215    227    202];  
>> B = [169    157    170    162    167];
```

Let $W = A - B$

```
>> Xw = mean(A) - mean(B)  
Xw =    52.4000  
  
>> Vw = var(A) + var(B);  
>> Sw = sqrt(Vw)  
Sw =    11.1714
```

The t-score for any given Monte-Carlo run

```
>> t = Xw / Sw  
  
t =    4.6906
```

From StatTrek, this corresponds to a probability of 0.99533

I'm 99.53% certain that I'll get more straight-flushes than 4-of-a-kinds in a Monte Carlo simulation of 100,000 hands of 7 card stud

- 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

Probability

Degrees of freedom

t-score

P(T ≤ 4.6906)

Calculate

The t-score for the population

```
>> t = Xw / ( Sw / sqrt(5) )
```

```
t = 10.4884
```

From StatTrek, this corresponds to a probability of 0.999766

I'm 99.97% certain that it's easier to get a straight-flush than 4-of-a-kind in 7-card stud

- 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

Probability

Degrees of freedom

t-score

P(T ≤ 10.4844)

Calculate

4) From the results, it *looks* like it's easier to get a straight than a 3-of-a-kind

- What is the probability that you'll get more straights than 3-of-a-kind hands next time you deal out 100,000 hands?
- What is the probability that it actually *is* more likely to be dealt a straight than 3-of-a-kind in 7-card poker?

Let

- Population A be straight
- Population B be 3-of-a-kind

```
>> A = [5166 4992 5084 5118 5083];  
>> B = [4766 4829 4824 4730 4763];
```

Let $W = A - B$

```
>> Xw = mean(A) - mean(B)  
Xw = 306.2000
```

```
>> Vw = var(A) + var(B);  
>> Sw = sqrt(Vw)  
Sw = 76.7014
```

Find the t-score for any given Monte-Carlo simulation of 100,000 hands

```
>> t = Xw / Sw  
  
t = 3.9921
```

From StatTrek, I'm 99.18% likely to get more straights than 3-of-a-kinds in a Monte-Carlo simulation of 100,000 hands of 7-card poker

- 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

3.9921

P(T ≤ 3.9921)

0.991882

Calculate

The t-score for the population is

```
>> t = Xw / ( Sw / sqrt(5) )
```

```
t = 8.9266
```

From StatTrek, this corresponds to a probability of 0.999565

I'm 99.95% certain that it's easier to get a straight than a 3-of-a-kind in 7-card stud

- 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

8.9266

P(T ≤ 8.9266)

0.999565

Calculate