t Test vs Z Test

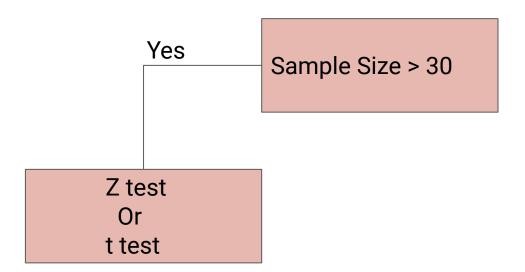




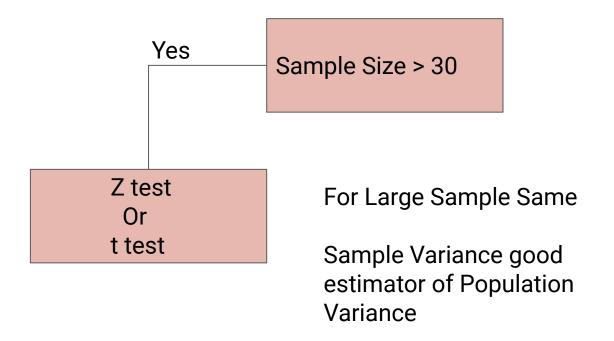


Sample Size > 30

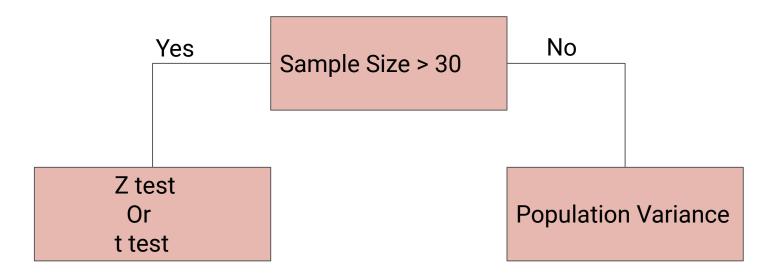




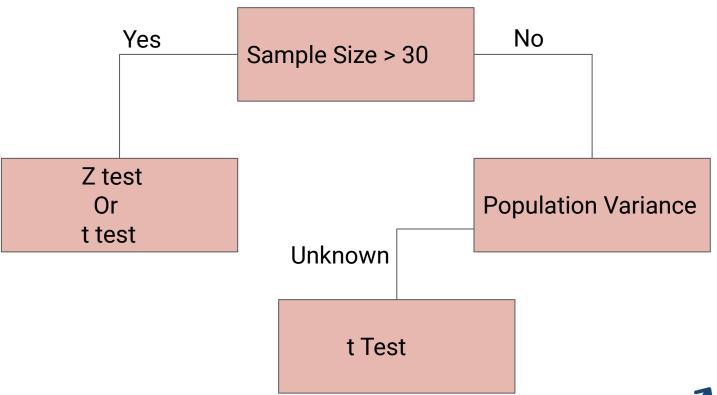




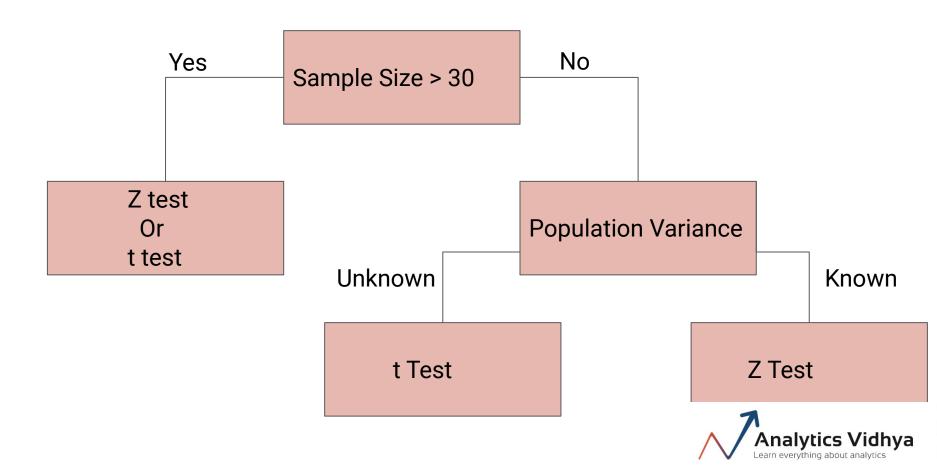














A paired t-test is used when we are interested in the difference between two variables for the same subject.



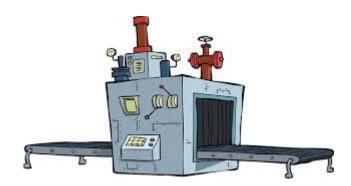
A paired t-test is used when we are interested in the difference between two variables for the same subject.

Ex: Recovery of Covid Patients before and after hydroxychloroquine drugs





A paired t-test is used when we are interested in the difference between two variables for the same subject.



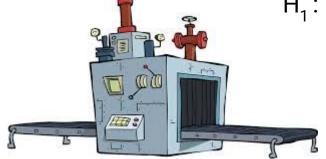


A paired t-test is used when we are interested in the difference between two variables for the same subject.

Ex: Improvement in Production after using advanced manufacturing machine.

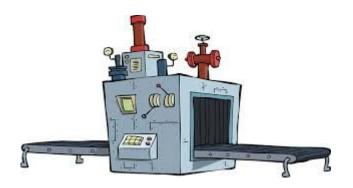
H₀: Production doesn't improve

H₁: Production does improve





Ex: Improvement in Production after using advanced manufacturing machine.



Day
1.0

2.0

3.0

- 0

6.0

7.0

3.0

9.0

10.0

12.0

14.0

15.0

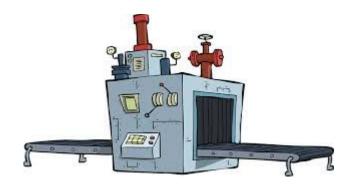
16.0

17.0

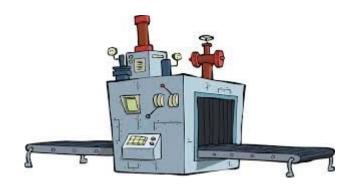
18.0

19.0

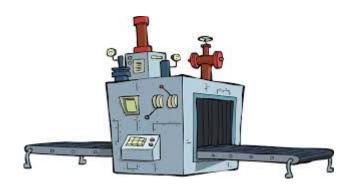
20.



ay	Before P	roduction
1.0		1800
2.0		2100
3.0		1600
4.0		2200
5.0		1900
6.0		2400
7.0		1700
8.0		2100
9.0		2300
0.0		1800
1.0		1400
2.0		1600
3.0		1600
4.0		1900
5.0		1800
6.0		2000
7.0		1200
8.0		2200
9.0		1500
0.0		1700



Day Before F 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 11.0 12.0 13.0 14.0	Before Production	After Production
1.0	1800	2200
2.0	2100	2500
3.0	1600	1700
4.0	2200	2400
5.0	1900	1600
6.0	2400	2900
7.0	1700	2000
8.0	2100	2300
9.0	2300	1900
10.0	1800	2000
11.0	1400	1500
12.0	1600	1500
13.0	1600	1800
14.0	1900	2600
15.0	1800	1800
16.0	2000	2400
17.0	1200	1800
18.0	2200	2500
19.0	1500	1900
20.0	1700	1600



Day	Before Production	After Production	Difference
1.0	1800	2200	400
2.0	2100	2500	400
3.0	1600	1700	100
4.0	2200	2400	200
5.0	1900	1600	-300
6.0	2400	2900	500
7.0	1700	2000	300
8.0	2100	2300	200
9.0	2300	1900	-400
10.0	1800	2000	200
11.0	1400	1500	100
12.0	1600	1500	-100
13.0	1600	1800	200
14.0	1900	2600	700
15.0	1800	1800	0
16.0	2000	2400	400
17.0	1200	1800	600
18.0	2200	2500	300
19.0	1500	1900	400
20.0	1700	1600	-100

$$t_{calc} = \frac{\overline{d}}{S_d / \sqrt{n}}$$

Day	Before Production	After Production	Difference
1.0	1800	2200	400
2.0	2100	2500	400
3.0	1600	1700	100
4.0	2200	2400	200
5.0	1900	1600	-300
6.0	2400	2900	500
7.0	1700	2000	300
8.0	2100	2300	200
9.0	2300	1900	-400
10.0	1800	2000	200
11.0	1400	1500	100
12.0	1600	1500	-100
13.0	1600	1800	200
14.0	1900	2600	700
15.0	1800	1800	0
16.0	2000	2400	400
17.0	1200	1800	600
18.0	2200	2500	300
19.0	1500	1900	400
20.0	1700	1600	-100

Ex: Improvement in Production after using advanced manufacturing machine.

$$t_{calc} = \frac{\overline{d}}{s_d / \sqrt{n}}$$

 → Mean of difference observed

 ⇒ Standard deviation of difference observed

 ⇒ Sample Size

Day	Before Production	After Production	Difference
1.0	1800	2200	400
2.0	2100	2500	400
3.0	1600	1700	100
4.0	2200	2400	200
5.0	1900	1600	-300
6.0	2400	2900	500
7.0	1700	2000	300
8.0	2100	2300	200
9.0	2300	1900	-400
10.0	1800	2000	200
11.0	1400	1500	100
12.0	1600	1500	-100
13.0	1600	1800	200
14.0	1900	2600	700
15.0	1800	1800	0
16.0	2000	2400	400
17.0	1200	1800	600
18.0	2200	2500	300
19.0	1500	1900	400
20.0	1700	1600	-100

$$t_{calc} = \frac{\overline{d}}{\frac{S_d}{\sqrt{n}}}$$

\overline{d}	\rightarrow 205
S_d	\rightarrow 283.72
n	\rightarrow 20

Day	Before Production	After Production	Difference
1.0	1800	2200	400
2.0	2100	2500	400
3.0	1600	1700	100
4.0	2200	2400	200
5.0	1900	1600	-300
6.0	2400	2900	500
7.0	1700	2000	300
8.0	2100	2300	200
9.0	2300	1900	-400
0.0	1800	2000	200
1.0	1400	1500	100
2.0	1600	1500	-100
3.0	1600	1800	200
4.0	1900	2600	700
5.0	1800	1800	0
6.0	2000	2400	400
7.0	1200	1800	600
8.0	2200	2500	300
19.0	1500	1900	400
0.0	1700	1600	-100

$$t_{cole} = 3.231$$

Ex: Improvement in Production after using advanced manufacturing machine.

$$t_{calc} = 3.231$$

t Table cum. prob t.50 t.75 t .80 t .85 t .975 0.50 0.25 0.20 0.15 0.10 0.05 0.025 0.01 0.005 0.001 0.0005 one-tail 1.00 0.50 0.40 0.30 0.20 0.10 0.05 0.02 0.01 0.002 0.001 two-tails 0.000 1.000 1.376 1.963 3.078 6.314 12.71 31.82 63.66 318.31 636.62 0.000 0.816 1.061 1.386 1.886 2.920 4.303 6.965 9.925 22.327 31.599 0.000 0.765 0.978 1.250 1.638 2.353 3.182 4.541 5.841 10.215 12,924 0.000 0.741 0.941 1.190 1.533 2.132 2.776 3.747 4.604 7.173 8.610 0.920 1.476 0.000 0.727 1.156 2.015 2.571 3.365 4.032 5.893 6.869 0.000 0.718 0.906 1.134 1.440 1.943 2.447 3.143 3.707 5.208 5.959 5.408 0.000 0.711 0.896 1.119 1.415 1.895 2.365 2.998 3,499 4.785 0.000 0.706 0.889 1.108 1.397 1.860 2.306 2.896 3.355 4.501 5.041 0.703 0.883 1.383 2.262 2.821 3.250 4.297 4.781 0.000 1.100 1.833 0.000 0.700 0.879 1.093 1.372 1.812 2.228 2.764 3.169 4.144 4.587 4.437 0.000 0.697 0.876 1.088 1.363 1.796 2.201 2.718 3.106 4.025 0.873 1.356 2.179 2.681 4.318 0.000 0.695 1.083 1.782 3.055 3.930 0.000 0.694 0.870 1.079 1.350 1.771 2.160 2.650 3.012 3.852 4.221 0.000 0.692 0.868 1.076 1.345 1.761 2.145 2.624 2.977 3.787 4.140 0.866 2.131 0.000 0.691 1.074 1.341 1.753 2.602 2.947 3.733 4.073 0.865 1.337 2.120 2,583 2.921 3.686 4.015 0.000 0.690 1.071 1.746 0.689 0.863 1.069 1.333 1.740 2.110 2.567 2.898 3.646 3.965 0.000 0.000 0.688 0.862 1.067 1.330 1.734 2.101 2.552 2.878 3.610 3.922 0.000 0.688 0.861 1.066 1.328 1.729 2.093 2.539 2.861 3.579 3.883 1.064 1.325 1.725 2.086 2.528 2.845 3.552 3.850 0.000 0.687 0.860

Ex: Improvement in Production after using advanced manufacturing machine.

$$t_{calc} = 3.231$$

t Table cum. prob t.50 t.75 t .80 t .85 t .975 0.50 0.25 0.20 0.15 0.10 0.05 0.025 0.01 0.005 0.001 0.0005 one-tail 1.00 0.50 0.40 0,30 0.20 0.10 0.05 0.02 0.01 0.002 0.001 two-tails 636.62 0.000 1.000 1.376 1.963 3.078 6.314 12.71 31.82 63.66 318.31 0.000 0.816 1.061 1.386 1.886 2.920 4.303 6.965 9.925 22.327 31.599 0.000 0.765 0.978 1.250 1.638 2.353 3.182 4.541 5.841 10.215 12.924 4.604 0.000 0.741 0.941 1.190 1.533 2.132 2.776 3.747 7.173 8.610 0.920 1.476 2.571 3,365 4.032 6.869 0.000 0.727 1.156 2.015 5.893 3.707 5.959 0.000 0.718 0.906 1.134 1.440 1.943 2.447 3.143 5.208 2.998 3.499 5.408 0.000 0.711 0.896 1.119 1.415 1.895 2.365 4.785 0.000 0.706 0.889 1.108 1.397 1.860 2.306 2.896 3.355 4.501 5.041 0.883 1.383 2.262 2.821 3.250 4.297 4.781 0.000 0.703 1.100 1.833 0.000 0.700 0.879 1.093 1.372 1.812 2.228 2.764 3.169 4.144 4.587 3.106 4.025 4.437 0.000 0.697 0.876 1.088 1.363 1.796 2.201 2.718 0.873 1.356 2.179 2.681 3.055 3.930 4.318 0.000 0.695 1.083 1.782 0.000 0.694 0.870 1.079 1.350 1.771 2.160 2.650 3.012 3.852 4.221 2.977 4.140 0.000 0.692 0.868 1.076 1.345 1.761 2.145 2.624 3.787 2.131 2.602 2.947 3.733 0.000 0.691 0.866 1.074 1.341 1.753 4.073 0.865 1.337 2.120 2,583 2.921 3.686 4.015 0.000 0.690 1.071 1.746 0.000 0.689 0.863 1.069 1.333 1.740 2.110 2.567 2.898 3.646 3.965 0.000 0.688 0.862 1.067 1.330 1.734 2.101 2.552 2.878 3.610 3.922 2.002 2 5 20 3.883 1.064 1.725 2.528 2.845 3.552 3.850 0.000 0.687 0.860 1.325 2.086

Ex: Improvement in Production after using advanced manufacturing machine.

$$t_{calc} = 3.231$$

P value would be between 0.001 and 0.005.

t Table cum. prob t.50 t.75 0.50 0.25 0.20 0.15 0.10 0.05 0.025 0.01 0.005 0.001 0.0005 one-tail 1.00 0.50 0.40 0,30 0.20 0.10 0.05 0.02 0.01 0.002 0.001 two-tails 0.000 1.000 1.376 1.963 3.078 6.314 12.71 31.82 63.66 318.31 636.62 0.000 0.816 1.061 1.386 1.886 2.920 4.303 6.965 9.925 22.327 31.599 0.000 0.765 0.978 1.250 1.638 2.353 3.182 4.541 5.841 10.215 12,924 0.000 0.741 0.941 1.190 1.533 2.132 2.776 3.747 4.604 7.173 8.610 0.920 1.476 4.032 0.000 0.727 1.156 2.015 2.571 3.365 5.893 6.869 0.000 0.718 0.906 1.134 1.440 1.943 2.447 3.143 3.707 5.208 5.959 3.499 0.000 0.711 0.896 1.119 1.415 1.895 2.365 2.998 4.785 5.408 0.000 0.706 0.889 1.108 1.397 1.860 2.306 2.896 3.355 4.501 5.041 0.883 1.383 2.262 2.821 3.250 4.297 4.781 0.000 0.703 1.100 1.833 0.000 0.700 0.879 1.093 1.372 1.812 2.228 2.764 3.169 4.144 4.587 3.106 4.025 4.437 0.000 0.697 0.876 1.088 1.363 1.796 2.201 2.718 0.873 2.179 2.681 3.055 3.930 4.318 0.000 0.695 1.083 1.356 1.782 0.000 0.694 0.870 1.079 1.350 1.771 2.160 2.650 3.012 3.852 4.221 2.977 0.000 0.692 0.868 1.076 1.345 1.761 2.145 2.624 3.787 4.140 2.947 3.733 0.000 0.691 0.866 1.074 1.341 1.753 2.131 2.602 4.073 0.865 1.337 2.120 2,583 2.921 3.686 4.015 0.000 0.690 1.071 1.746 0.000 0.689 0.863 1.069 1.333 1.740 2.110 2.567 2.898 3.646 3.965 0.000 0.688 0.862 1.067 1.330 1.734 2.101 2.552 2.878 3.610 3.922 3.883 1.064 1.725 2.845 3.850 0.000 0.687 0.860 1.325 2.086 2.528

+ Table

Ex: Improvement in Production after using advanced manufacturing machine.

$$t_{calc} = 3.231$$

P value would be between 0.001 and 0.005.

Exact P value = 0.004

cum. prob	t.50	t.75	t .80	t .85	t.90	t .95	t ,975	t .99	t.995	t,999	t .9995
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df	823 B/2 / 10 F	1000000000	0.5 10 20 20 20 20 20 20 20 20 20 20 20 20 20	104037500	VENE A1901 NO.	ACCESSION N	ROMODANO I	100000000	1172174174188	No tenero de tenero	Contract of the
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.600	0.061	1.066	1,320	1.720	2.003	2,530	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850

Ex: Improvement in Production after using advanced manufacturing machine.

$$t_{calc} = 3.231$$

P value would be between 0.001 and 0.005.

Exact P value = 0.004

cum. prob	t.50	t.75	t .80	t .85	t.90	t.95	t ,975	t .99	t.995	t,999	t ,9995
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df	H2 - 48/07/01/19	1000000000	0.5 10 20 20 20 20 20 20 20 20 20 20 20 20 20	104037500	VENE A1901 NO.	7-000-00-00	ROMOUNTAL F	100000000	17217419586	Notes and Section	
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.600	0.061	1.066	1,320	1.720	2.003	2,530	2.961	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850

P value < 0.05

A paired t-test is used when we are interested in the difference between two variables for the same subject.

Ex: Improvement in Production after using advanced manufacturing machine.

H₀: Production doesn't improve

H₁: Production does improve



Thank You!

