Student-t test assumes 2 groups with same variance. Does this m

Difference between this and analysis of means.

Analysis of means:
https://programs.theanalysisfactor.com/statistically-speaking/trainings/analysis-of-means/

Quality Control examples. Going to point out contra indications which nobody covers. When you shouldn't use it.

Example: Monsoon distribution. Each region is a group.
Example: referral patterns for physicians. Each physicians will have different referrals.
Example: Analyisis of Means(ANOM) as a tool for comparison of Sample Treatment methods.

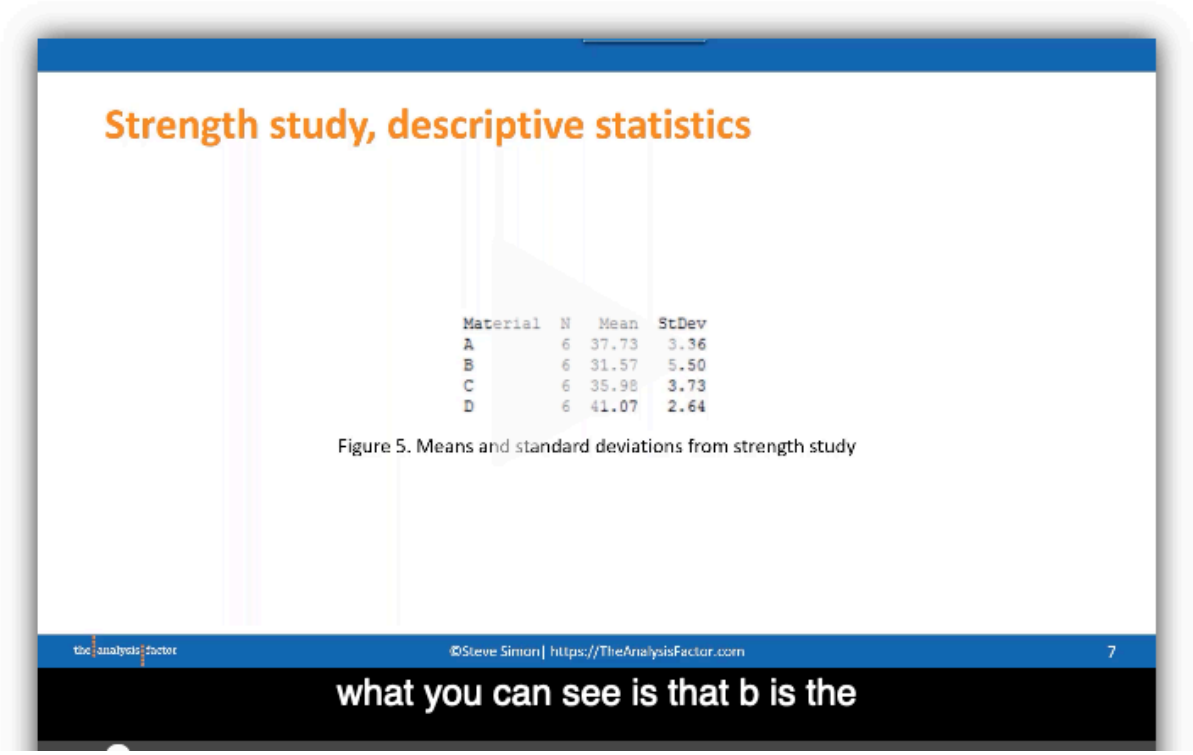
When you have different groups the first thing people think of is ANOVA or analysis of variance.

1) ANOVA vs ANOM. When to use ANOVA vs ANOM.
2) Control charts. There is a similarity between control charts and analysis of means. How to recognize when you should use a control chart vs. using an ANOM.

ANOVA: Illustrating ANOVA with strength study.

Stat's Amore Training Video: Analysis of Means

Please allow some time for video to appear below

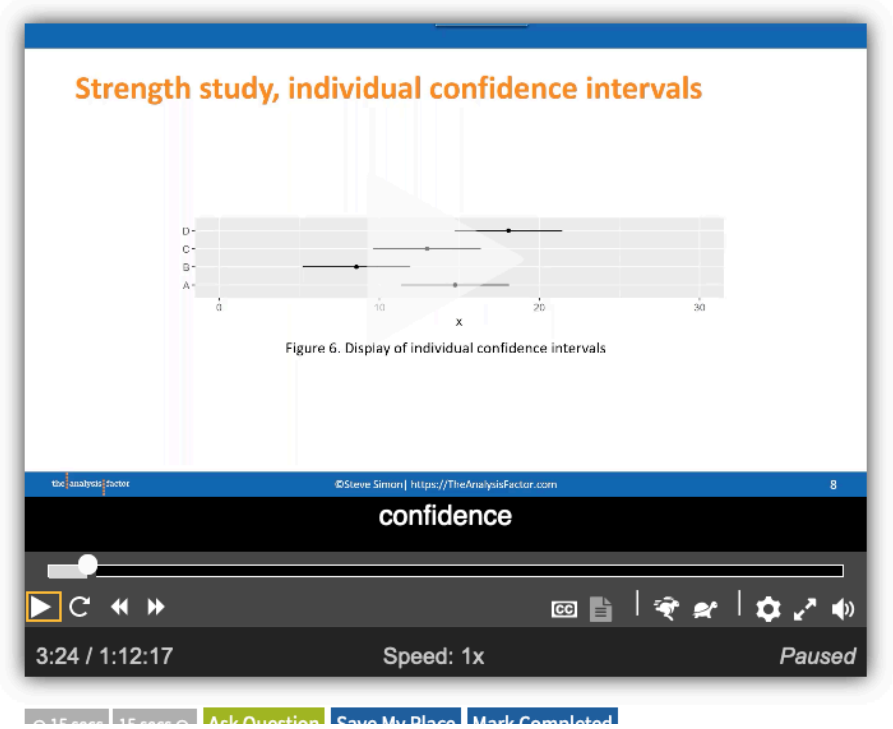


4 groups with means and std deviation. Comparing the material strength of the 4 groups. B is the weakest and D is the strongest.

He drew some confidence intervals

Stat's Amore Training Video: Analysis of Means

Please allow some time for video to appear below



If 2 intervals touch then one mean is not statistically significant from the other mean. This rule is wrong.

If the mean of one lies in the CI of another then it isn't statistically significant different. This rule doesn't work

Are A and B statistically significant different or same? Have to adjust we aren't looking at just A and B but all possible pairwise comparison in ANOVA framework.

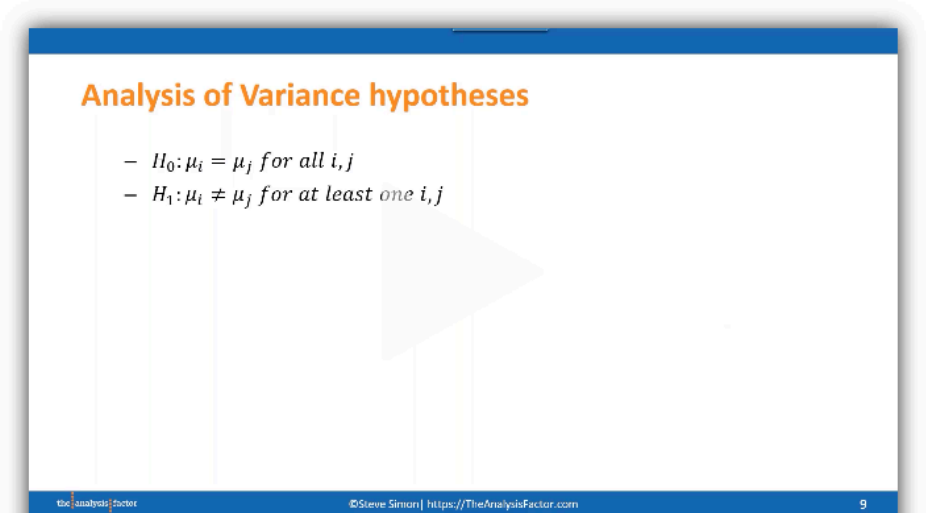
SO individual CI won't work for which material is strongest and which one is weakest.

B and D do not overlap. There is a difference but this difference may not be there after adjusting for multiple comparisons.

ANOVA hypothesis testing.

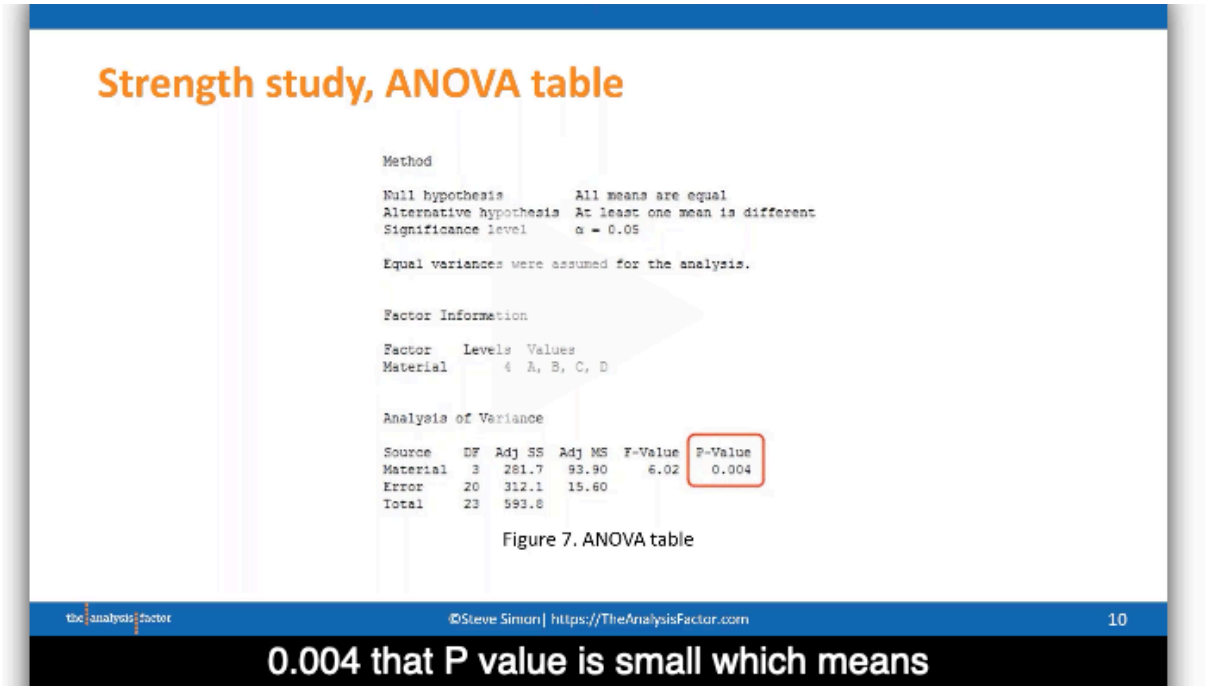
Stat's Amore Training Video: Analysis of Means

Please allow some time for video to appear below



Null hypothesis means are equal for all groups.
AH: at least 1 mean not equal.

SO you have to compare all the pairings. From the example above
AB
AC
AC
AD
BC
BD
To see if the null hypothesis is accepted or rejected.
Cant do multiple tests and take smallest pvalue. Have to make an adjustment for running multiple tests.
Verify video 8.27 this is bonferroni correction.



The p-value is small so there is a statistically significant difference amongst at least 1 pair of means.

What does the F-Value mean?
DF, Adj RR.

Tukey pairwise comparison of means.

Please allow some time for video to appear below

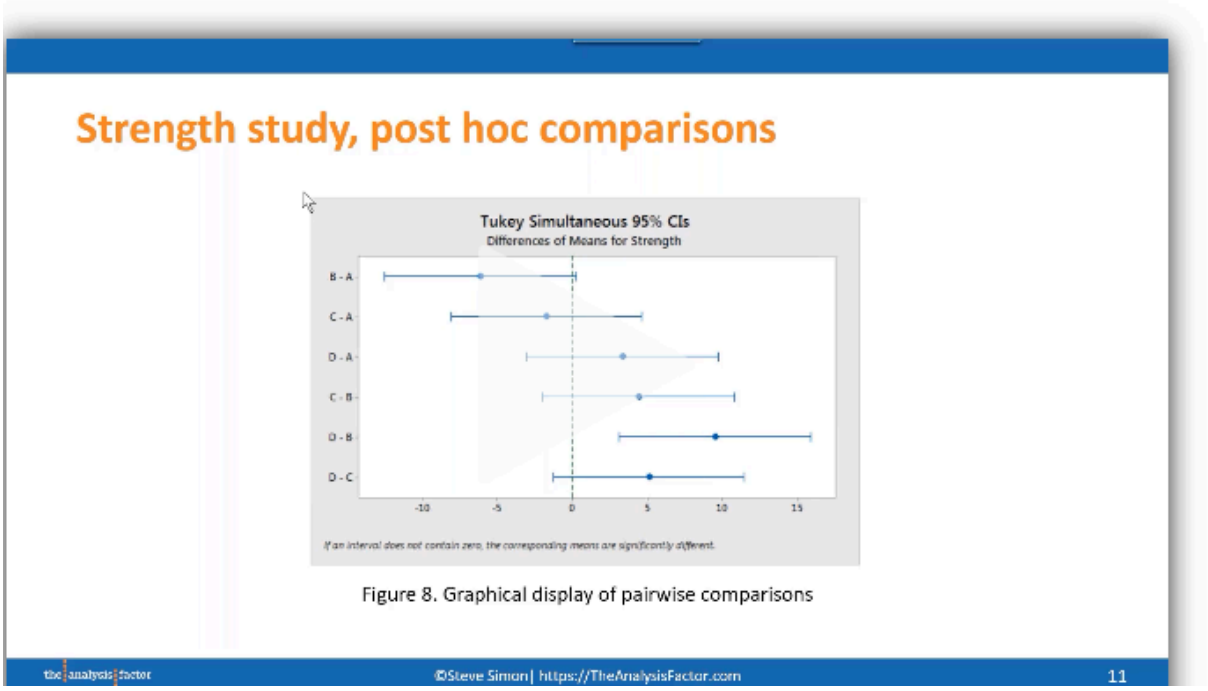


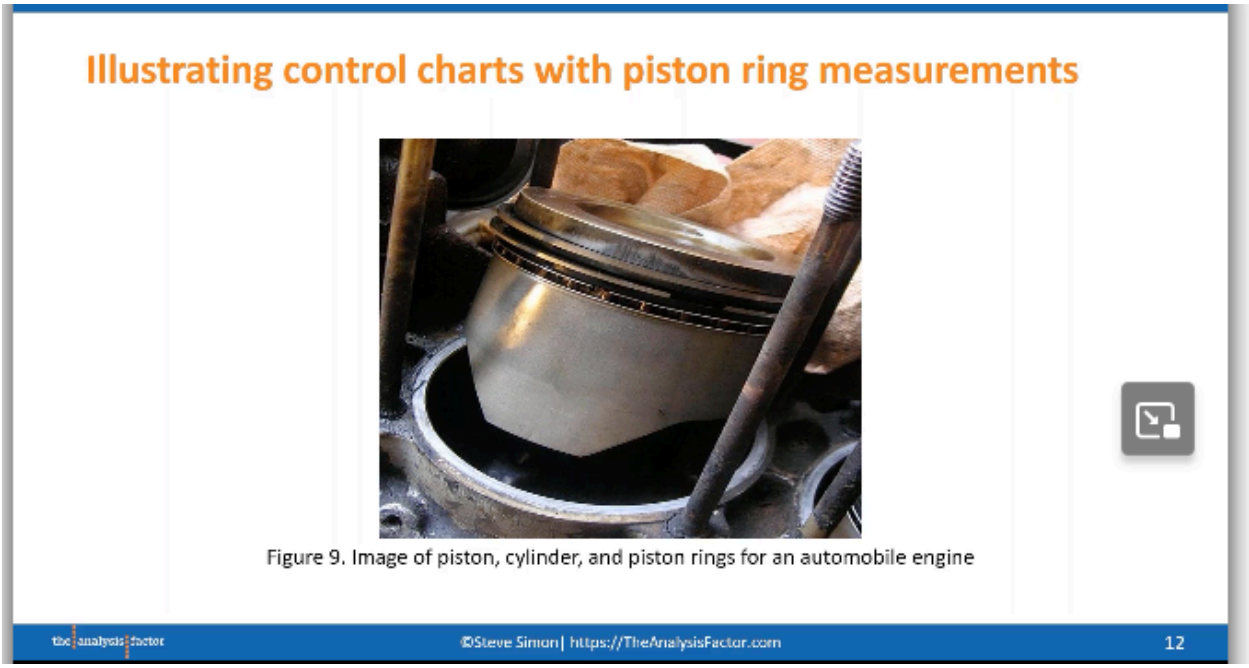
Figure 8. Graphical display of pairwise comparisons

A CI which includes 0 means there is no difference. Ci includes 0: B/A, C/A ,D/A, C/B, D/C,

What is null hypo? ALL MEANS same, D is different than B.
D/B is postitive so the D is stronger than B.

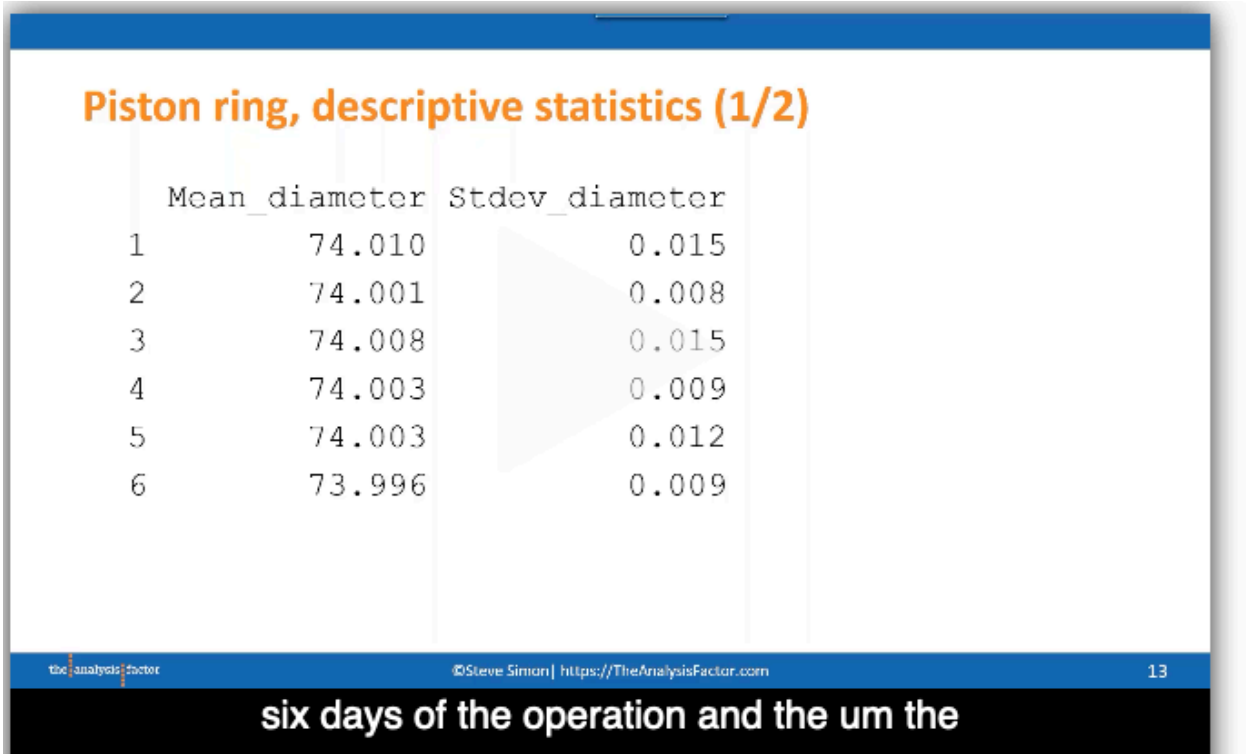
ANOVA gets worse when there are more categories.
Need more depth on this. What happens with more categories?

Control Charts:



Manufacturing piston rings.

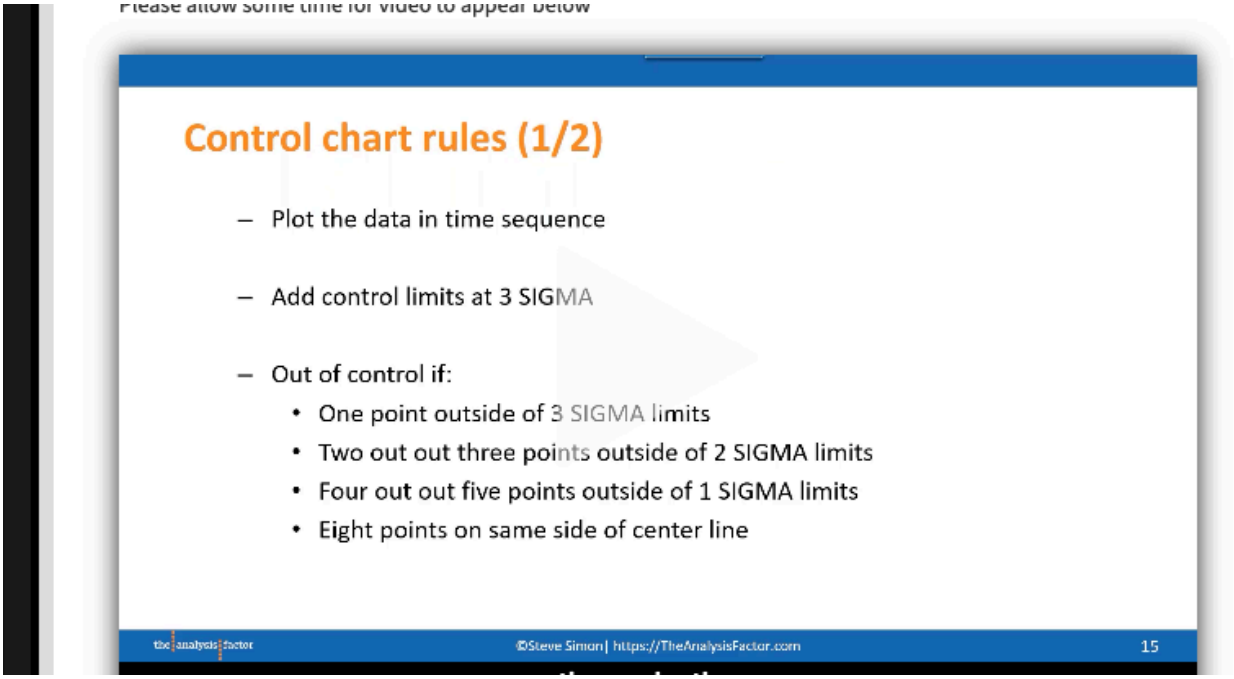
There first and last 6 days of manufacturing piston rings.Can see the mean diameter increasing at 37, the second digit is no longer 0.



Piston ring, descriptive statistics (2/2)

	Mean_diameter	Stdev_diameter
35	74.013	0.012
36	74.004	0.013
37	74.017	0.007
38	74.020	0.011
39	74.023	0.009
40	74.013	0.012

When did the diameters start getting big and how do you know?
Plot mean diameter in time sequence



Sigma is not same as std. deviation. Sigma is measure of short term variation.

3 sigma is a measure of short term variation. Any value out of 3 sigma a process is considered out of control.

Add other measures besides 3 sigma. If you wait to observe 3 sigma it may be too late.

Last point 8 points on same side of center line. Means you drifted vs 8 points randomly up and down on different sides of center line.

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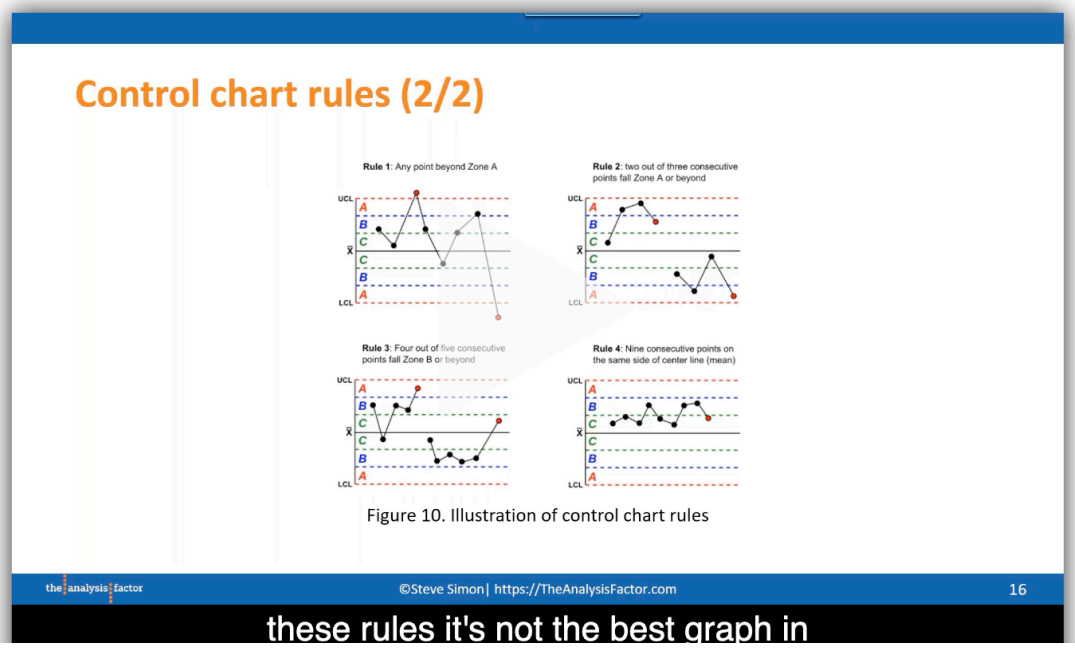
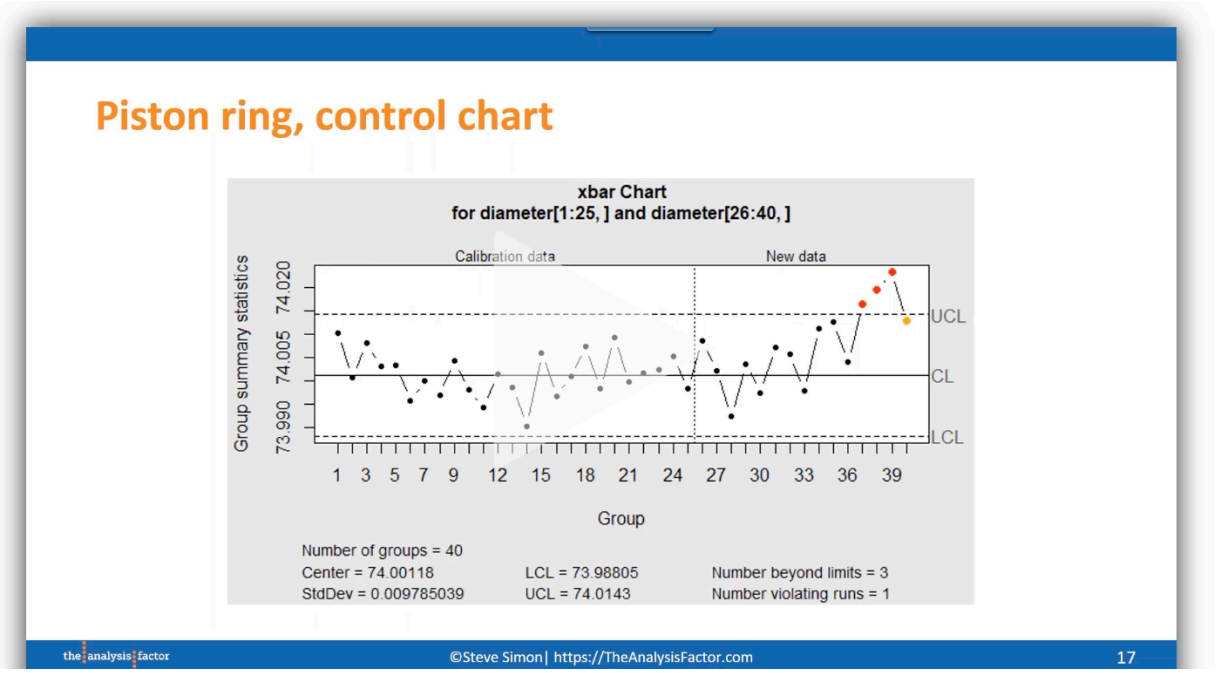


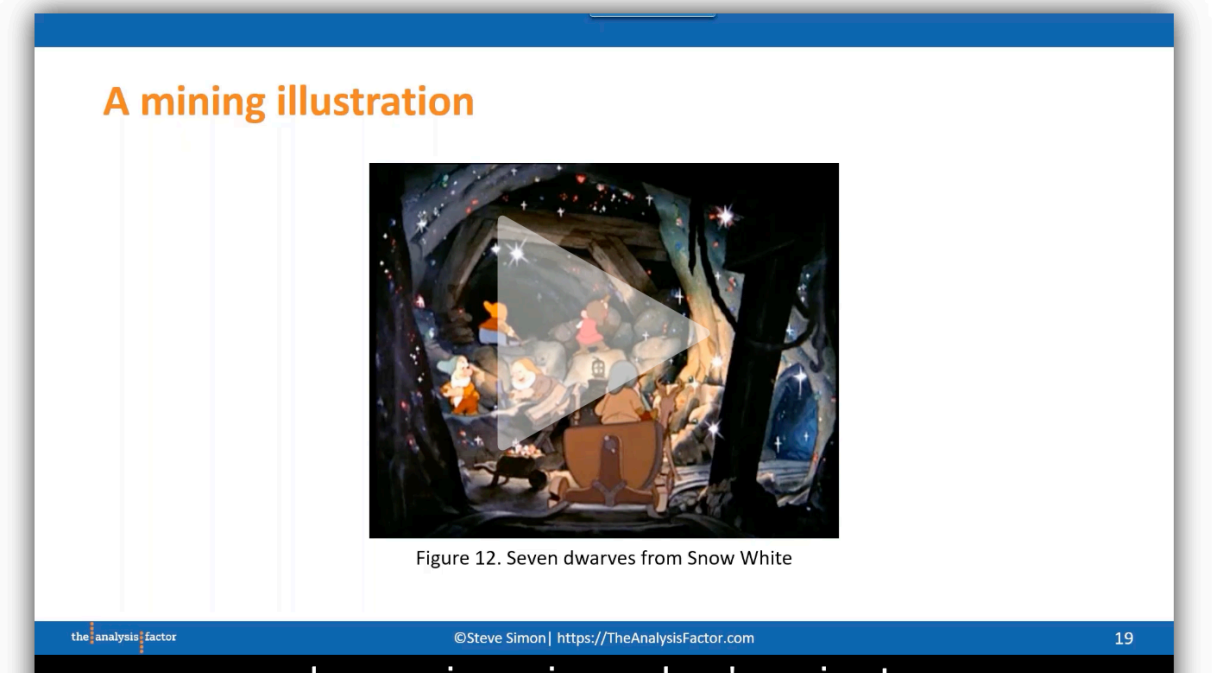
Figure 10. Illustration of control chart rules



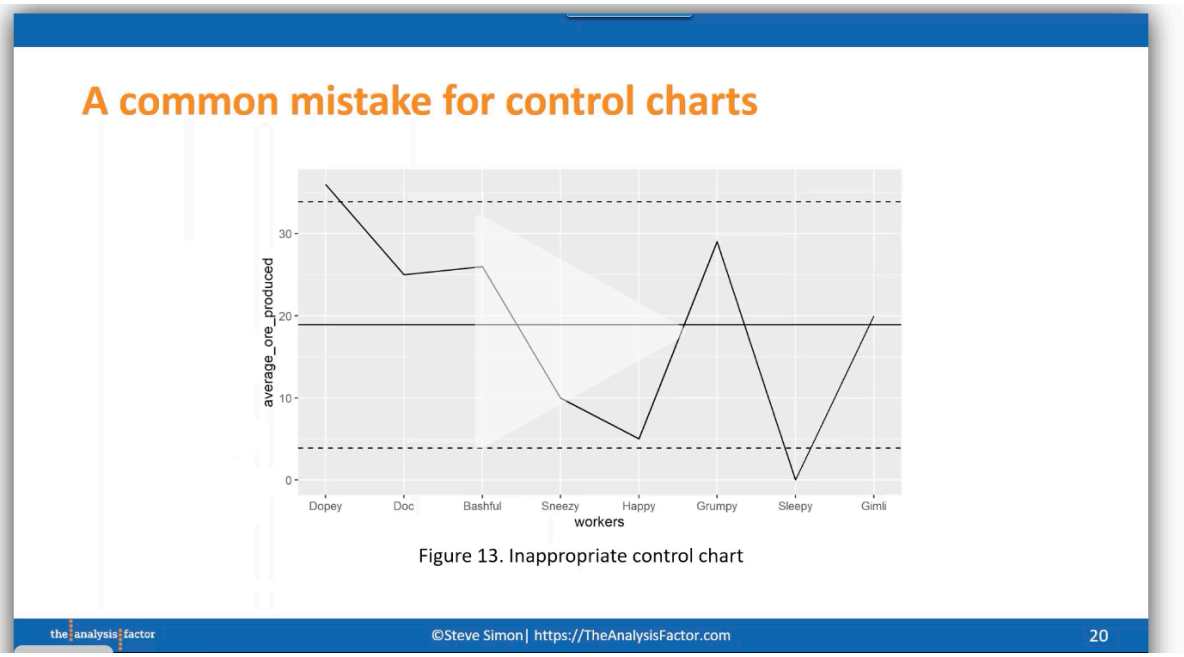
New data has 8 point above control line.

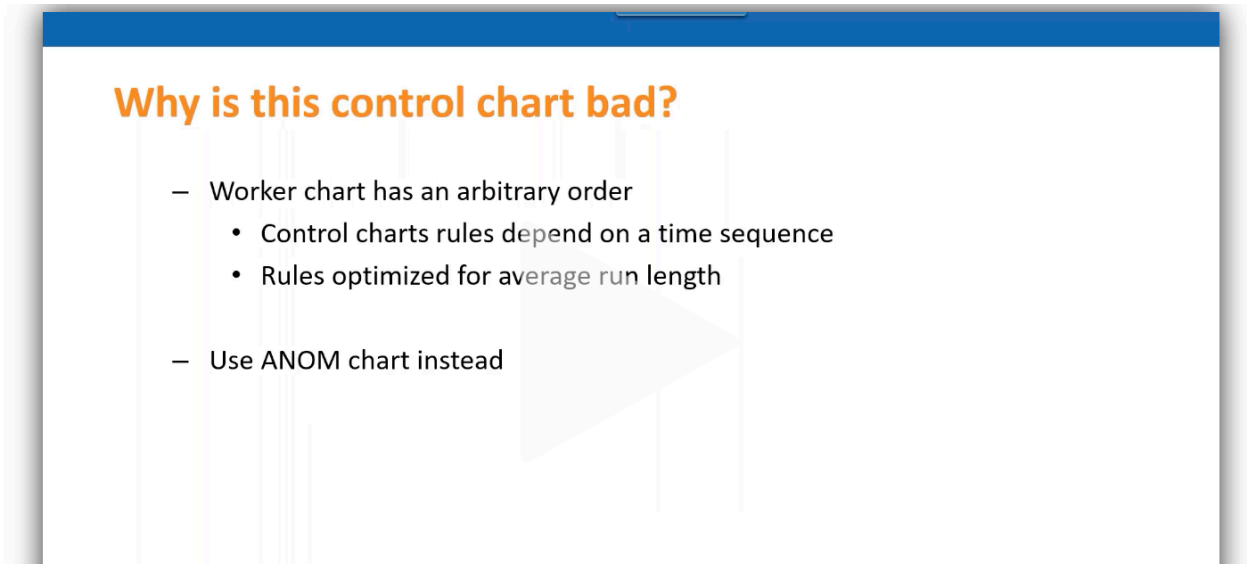
Example of something which wasn't a control chart:

Dwarves in a mine:



Mine output



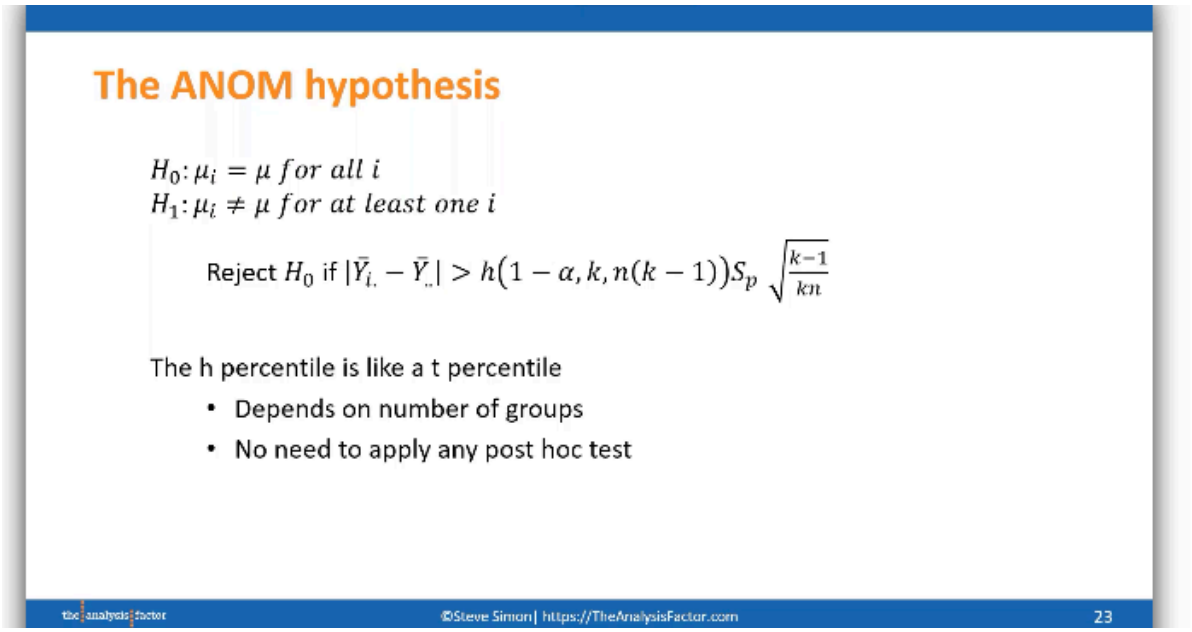


Average run length in manufacturing process. Want specific rules from observation. Cannot arbitrarily apply to different domain.

Framework for analysis of means:

Want to know if bone marrow measurements different between hospitals A B C D. What is pros and cons of ANOM vs Dunnitt's t test?

Dunnett's t-test compares all to a control. If hospital A is control then Dunnetts test better. ANOM does poorly when one of the groups is a control group. Look at 1 group vs. others then ANOM is not good, ANOVA followed by Dunnetts test better approach.



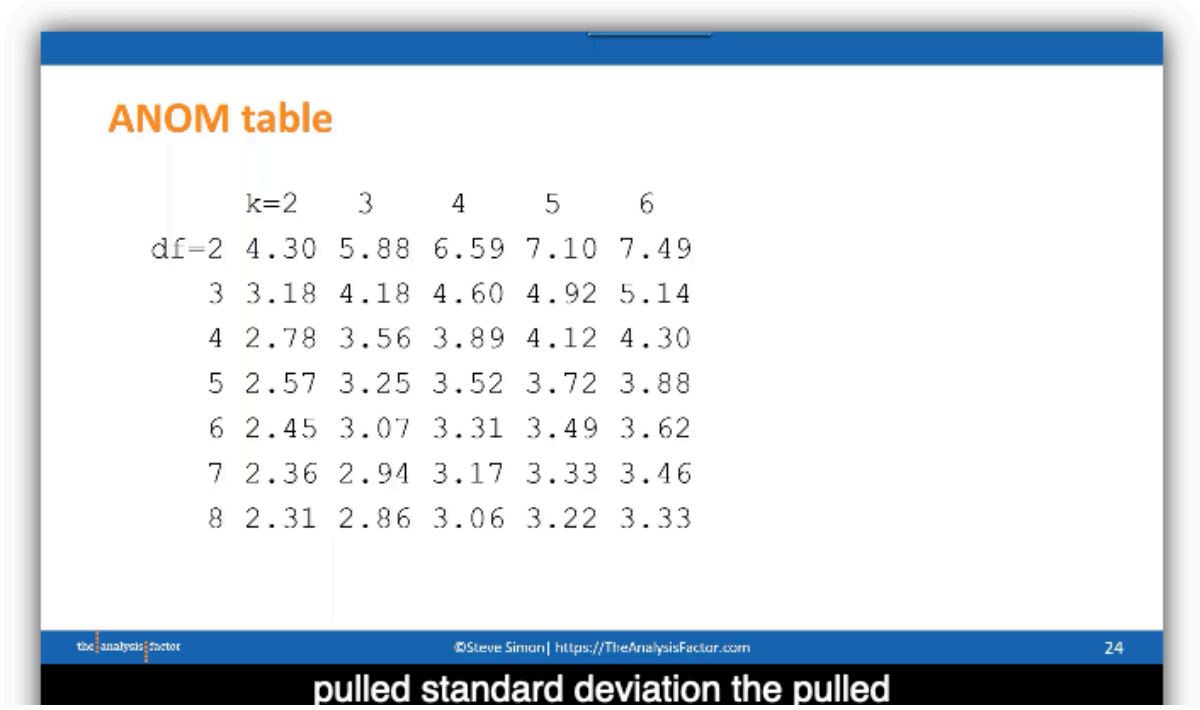
No J in ANOM. There is in ANOVA.

ANOM says there is a group different from the overall average. Find this group.
H percentile like t distribution but have to account for xxx.
There are K groups and making multiple comparisons. Different than each pair. There are 4 groups here vs 6 pairs we saw before. n(n-1)/2 = 6. 10 groups we look at pairs, 10*9/2 = 45 possible pairs. The complexity of

ANOVA is square of num of groups. ANOM is linear, same as N, compare each group vs. mean.

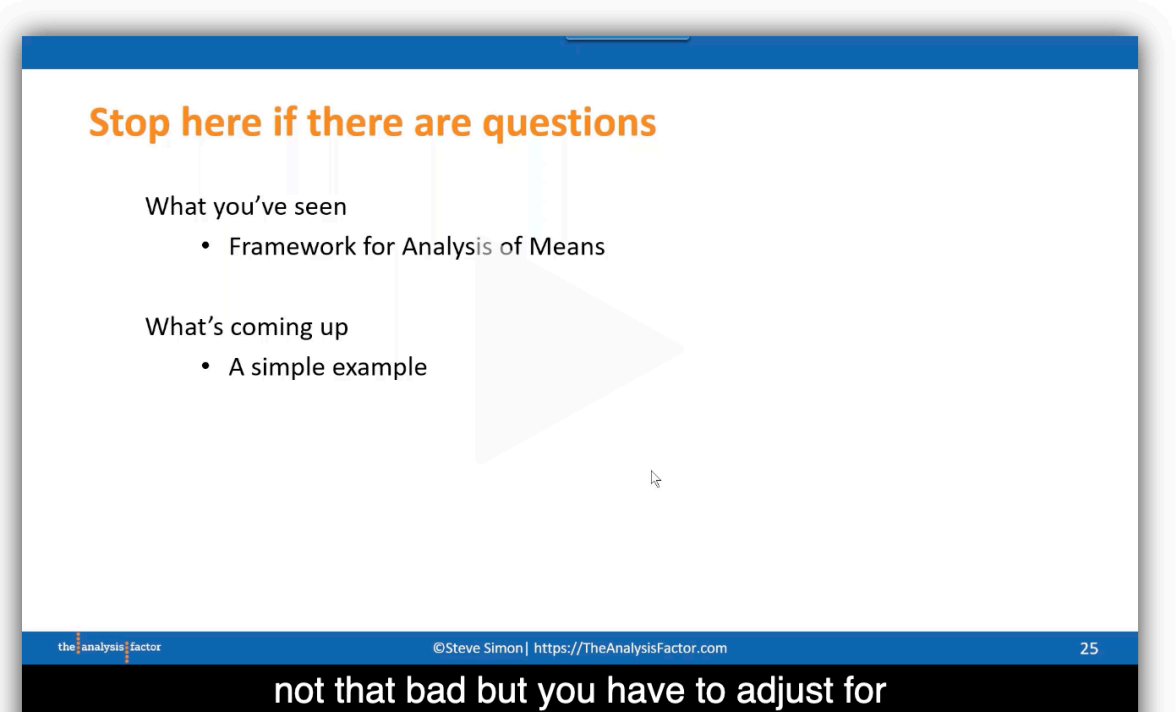
H percentile on web.

ANOM h percentile already adjusted for multiple comparisons. No need to post hoc adjust for multiple comparisons.



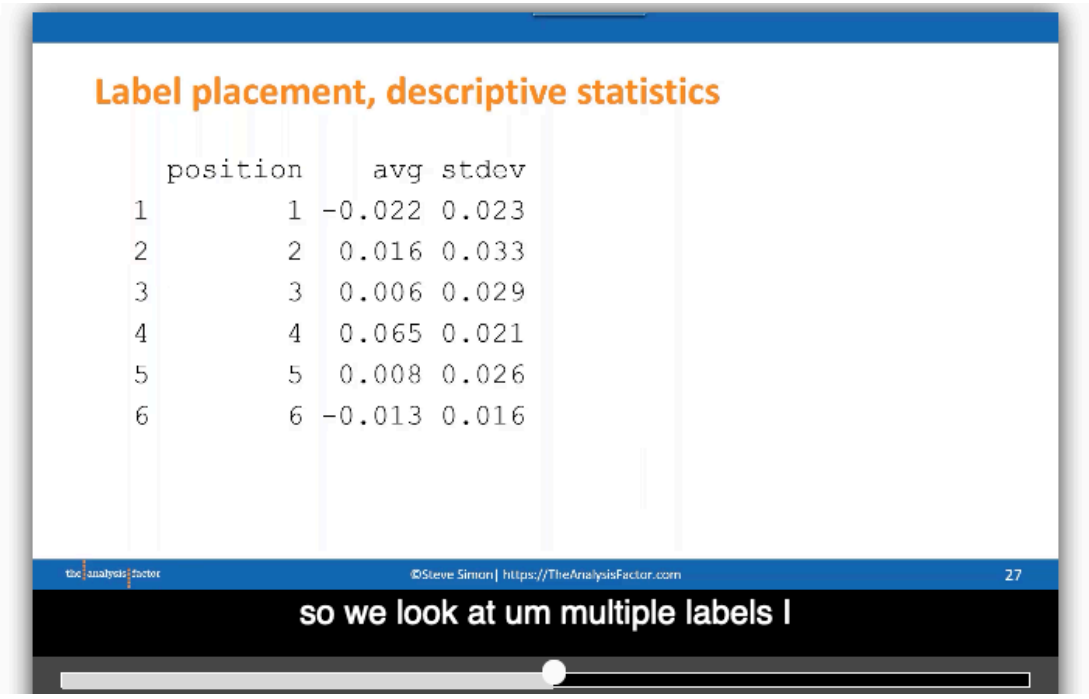
Have to adjust for group imbalance.

Please allow some time for video to appear below



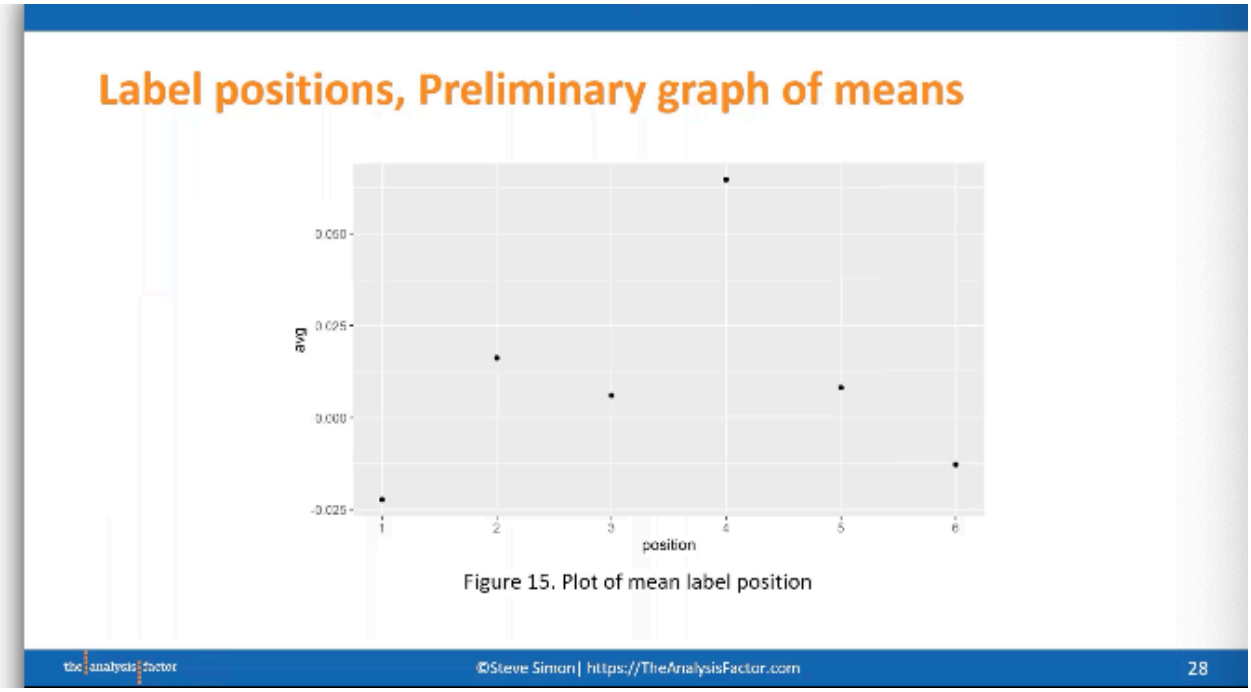
If different demographic groups differ from average can use ANOM if correct for imbalances.

Bottling plant example. Put labels on bottles.

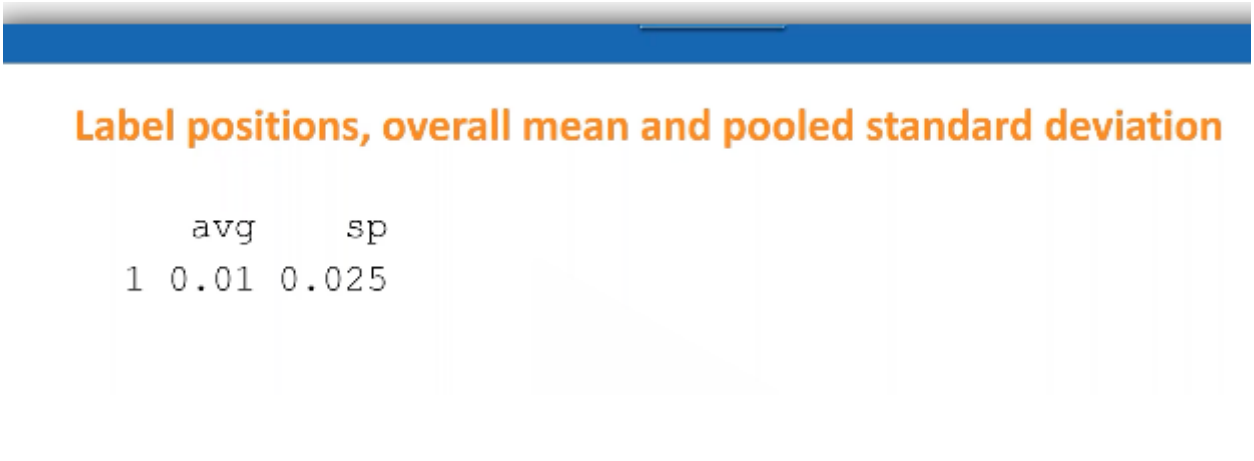


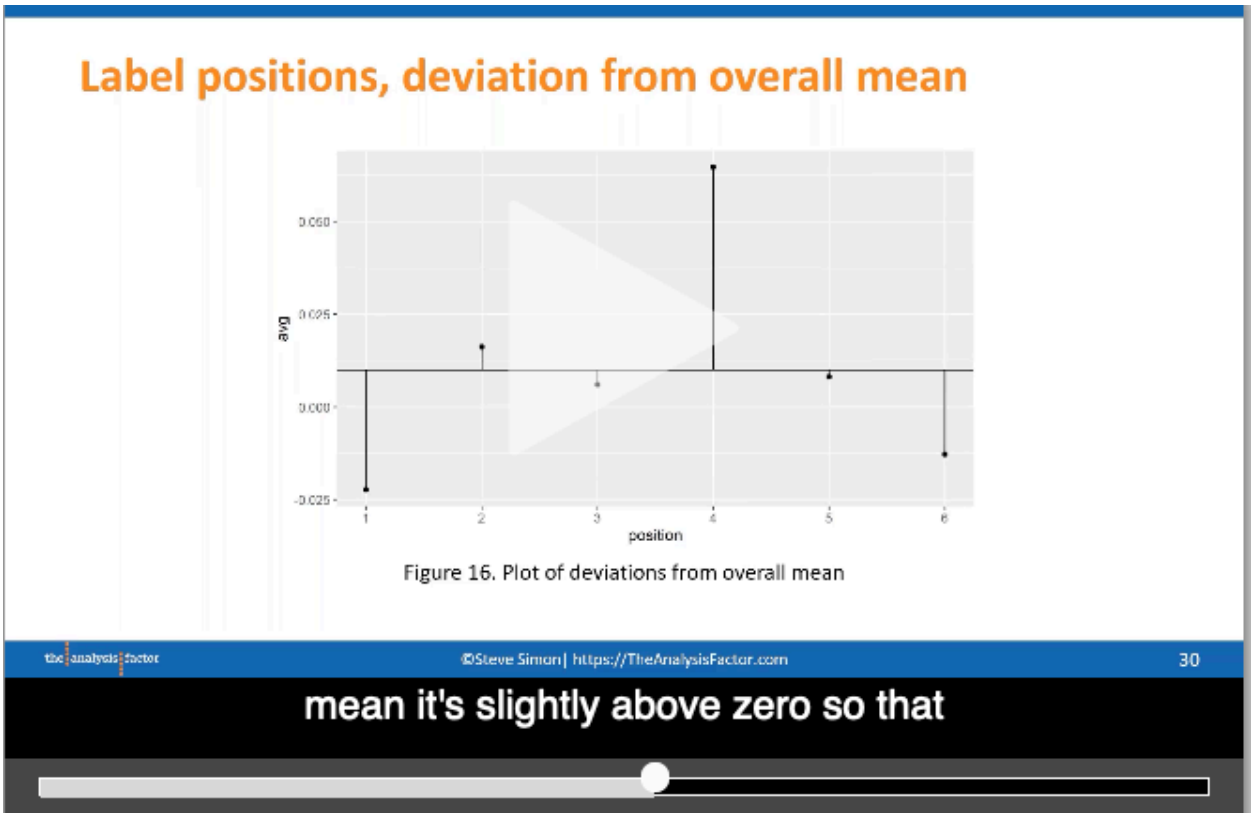
Position 1 and 6 are too low. 4 is too high. Is 4 different from the overall average? How about 2,3?

Plot



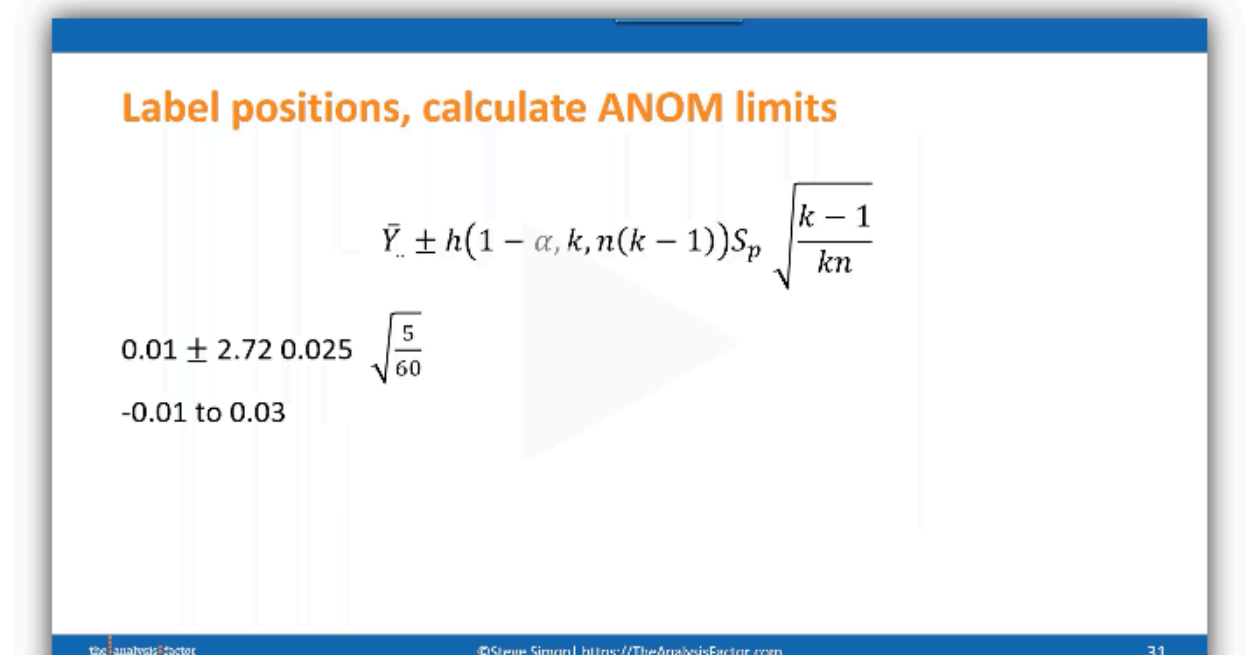
OVerall average is 0.01





ANOM uses overall mean Y and the h percentile. H percentage, k=Number of groups , 6, n=10.

39.44 what is alpha? .95?



Draw teh limit lines on teh graph. 4 is above the limit lines and 1 and 6 are below the limit lines.

Label positions, add limits to graph

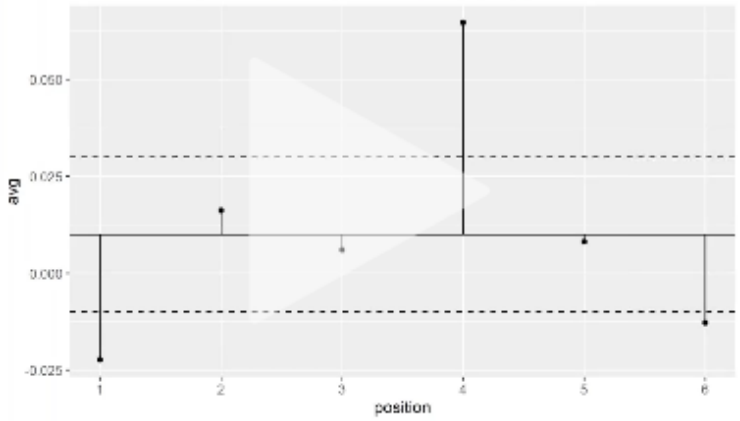


Figure 17. Plot with ANOM limits

ANOM can be used to see if you need a global calibration. Because the mean is straddled then no adjustment. But if on one side then calibrate with bias.

If you reject the ANOM hypothesis you make micro changes, if accept you make macro changes, ie calibrate everything up or down.

Stop here if there are questions

What you've seen

- A simple example

What's coming up

- Extensions to proportions and counts

C-sections

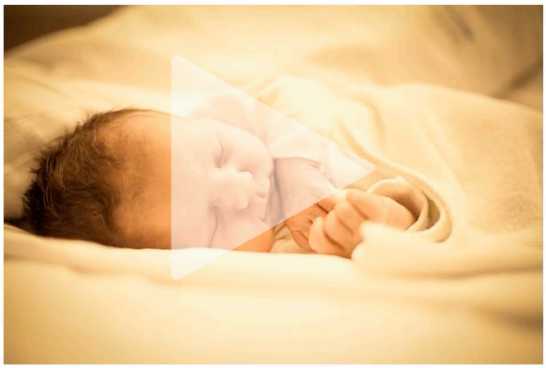


Figure 18. Image of newborn infant

Analysis of means for proportions

Two changes

- Proportions rather than means
- Unequal group sizes

Limits

- $\bar{p} \pm m(1-\alpha, k, \infty) \sqrt{\bar{p}(1-\bar{p})} \sqrt{\frac{N-n_i}{Nn_i}}$
- IMPORTANT!!! Limits change with i

P bar Bernoulli dist.N is num observations across all clinics. n_i=num observations in ith clinic.

C-sections, first six observations

	group	c_sections	births	prob
1	1A	150	923	0.16
2	1K	45	298	0.15
3	1B	34	170	0.20
4	1D	18	132	0.14
5	3I	20	106	0.19
6	3M	12	105	0.11

C-sections, preliminary plot

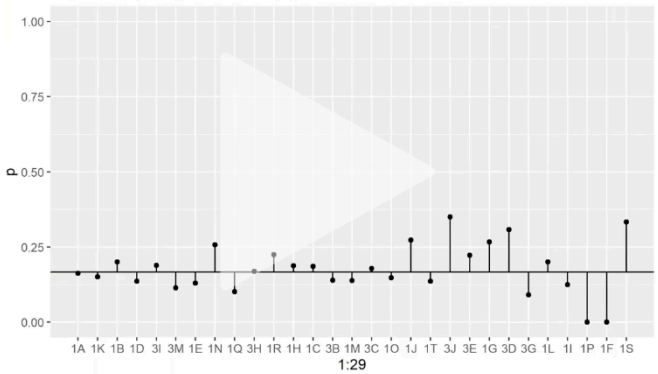


Figure 19. Plot of C-section proportions

C-sections, plot with ANOM limits

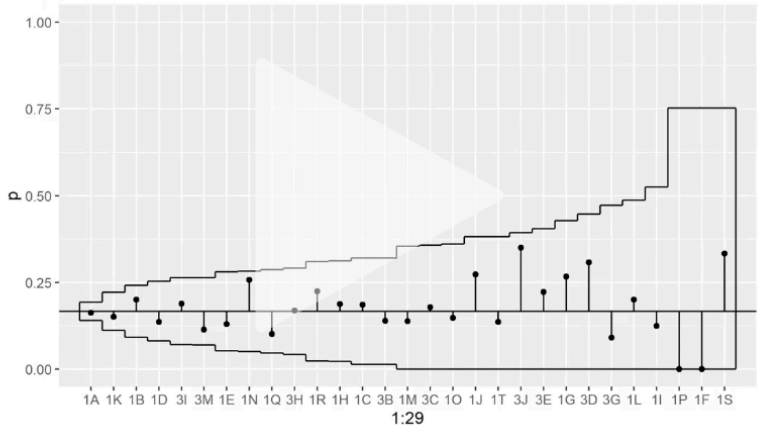


Figure 20. Plot of C-secton proportions with ANOM limits

Even though some clinic have c section rate. As high as 25% all clinic in random variation; within envelope

Evertthing in limit so accept null hypothesis
Since null hypothesis accepted we make macro changes to all 29 clinics.
Can we simulate this? 53.14 in video.

Can look at micro, clinics outside the anom envelope or macro at all clinics.
This says look macro.

You can look at demographics and for health care there are disparities where some groups are provided worse health care ANOM will show this.
Once you find anANOM disparity then focus micro on the group.