

Process Excellence Black Belt Exam
Closed Book Questions

Name: _____

- ✓ 1. Which tool is best used to separate special from common cause variability?
- ✓ 2. List three methodologies of Process Excellence at J&J?
- ✓ 3. List three reasons why a project charter should be used?
- ✓ 4. In your own words, briefly describe the purpose and at least one likely outcome (deliverable) of each step of the DMAIIC process.

Step	Purpose	Likely Outcome
Define		
Measure		
Analyze		
Innovative Improvement		
Control		

- 5. FMEA is a tool used to evaluate risk. It appears in both the Measure phase and Innovative Improvement. Describe the difference between how FMEA is used in these two phases.
- 6. What's the difference between statistical significance and practical significance?
- 7. List at least three things that influence sample size?

Name _____

8. Describe the general confounding in a resolution V statistically designed experiment.
9. What is a two-way interaction? Sketch a plot that demonstrates a two-way interaction that "exists"
10. What is the purpose of blocking in a DOE?
- ✓ 11. Name the DMAIIC tool that is used to graphically display potential critical X's.
- ✓ 12. Define process capability and describe what "Six Sigma" means related to this subject?
- ✓ 13. What is the difference between SPC limits and specification limits?
14. Give an example of where you might use a control chart for attributes within EES and tell what type of control chart you would utilize?

Name _____

15. Define alpha and beta error. What are EES recommended value of each?

✓ 16. What's the difference between a SIPOC, Activity Flow Chart and Deployment Flow Chart? When would you use each?

17. List at least 3 assumptions made about residuals in a regression analysis?

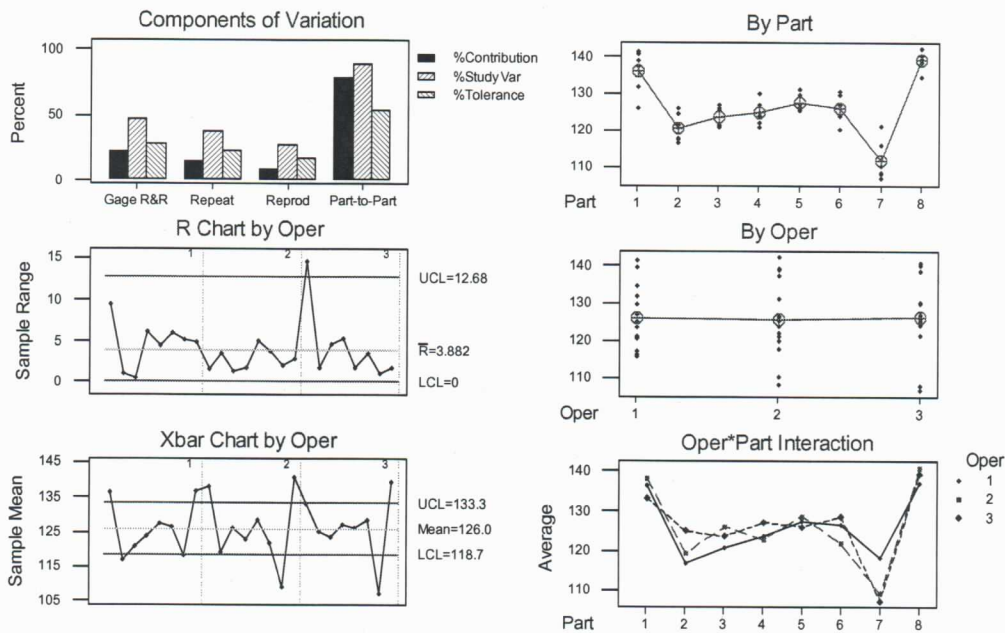
Name: _____

- ✓ 18. A Gage R&R study was performed on a micrometers ability to measure the length of a plastic part. The results of this study are given below. Interpret these results and state your conclusions and recommendations.

Note: output continued on next page.

Gage R&R (ANOVA) for Conc

Gage name:
Date of study:
Reported by:
Tolerance:
Misc:



18 (cont)

Gage R&R for Conc

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
Part	7	3083.55	440.507	17.5237	0.00001
Oper	2	2.09	1.043	0.0415	0.95949
Oper*Part	14	351.93	25.138	2.0535	0.05859
Repeatability	24	293.79	12.241		
Total	47	3731.36			

Source	VarComp	%Contribution (of VarComp)
Total Gage R&R	18.690	21.26
Repeatability	12.241	13.92
Reproducibility	6.448	7.33
Oper	0.000	0.00
Oper*Part	6.448	7.33
Part-To-Part	69.228	78.74
Total Variation	87.918	100.00

Name _____

Source	StdDev (SD)	Study Var (5.15*SD)	%Study Var (%SV)	%Tolerance (SV/Toler)
Total Gage R&R	4.32314	22.2642	46.11	27.83
Repeatability	3.49875	18.0186	37.31	22.52
Reproducibility	2.53934	13.0776	27.08	16.35
Oper	0.00000	0.0000	0.00	0.00
Oper*Part	2.53934	13.0776	27.08	16.35
Part-To-Part	8.32035	42.8498	88.74	53.56
Total Variation	9.37645	48.2887	100.00	60.36

Number of Distinct Categories = 3

- ✓ 19. A. Calculate the RTY for a 4 step process with the individual process step yields provided below:
- Step #1: 80%
 - Step #2: 95%
 - Step #3: 45%
 - Step #4: 90%

B. Which process step is most likely to provide improvement opportunities?

- ✓ 20. Describe the general process used to identify CTQ's.

21. List that appropriate hypothesis test for each of the following situations:

Situation	Hypothesis Tool
Determining whether the scrap rates are the same from two different suppliers	
Determining whether the cycle times are the same for getting material deliveries from three different suppliers	
Determining whether the variation is the same on three difference staple forming machines.	
Determining if the force applied to the product matches the value printed on the knob that sets the force.	

Name _____

22. List three **graphical** tools you could use to explore possible differences between 3 suppliers.
23. List at least three criteria that Process Excellence projects should be evaluated against.
24. Describe the pattern you would expect to see in plotting data from a normally distributed process on a normal probability plot?
25. You've determined that your data is not normally distributed and you need to transform it. What tool can you use to help identify effective transformations?
- ✓ 26. Two plastic parts are glued together to create a product. The total thickness of this assembly is CTQ. Given the information below, what do you predict the overall average and standard deviation of the assembly to be?

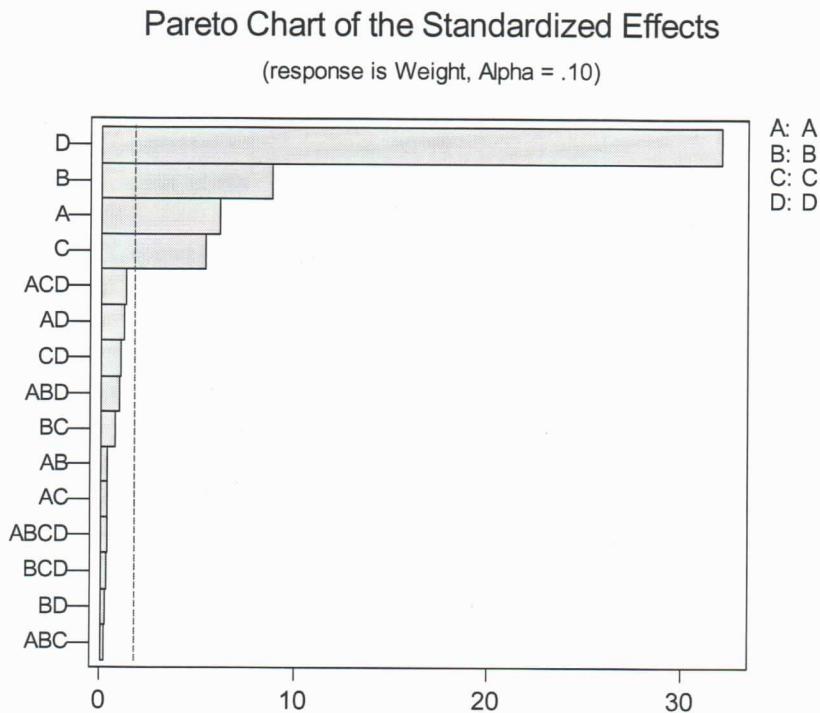
Component	avg thickness	stdev
Top	0.10	0.02
Glue	0.05	0.0001
Bottom	0.57	0.03

Overall average = _____

Overall Stdev = _____

27. What is the null hypothesis for testing the relationship between two variables (regression)?
28. You wish to design a 2^k experiment. What is the maximum number of factors that can be evaluated in 16 runs while maintaining a resolution IV? (hint: Use Minitab for guidance)

29. What conclusions do you draw from the following output from a 2^4 full factorial?



30. Use the DOE output below to predict the expected output of the following set up:
(Hint: Model may not be in its final form.)

Factor A: -1

Factor B: +1

Factor C: -1

Factor D: -1

Predicted length = _____

Fractional Factorial Fit: Length versus A, B, C, D

Estimated Effects and Coefficients for Length (coded units)

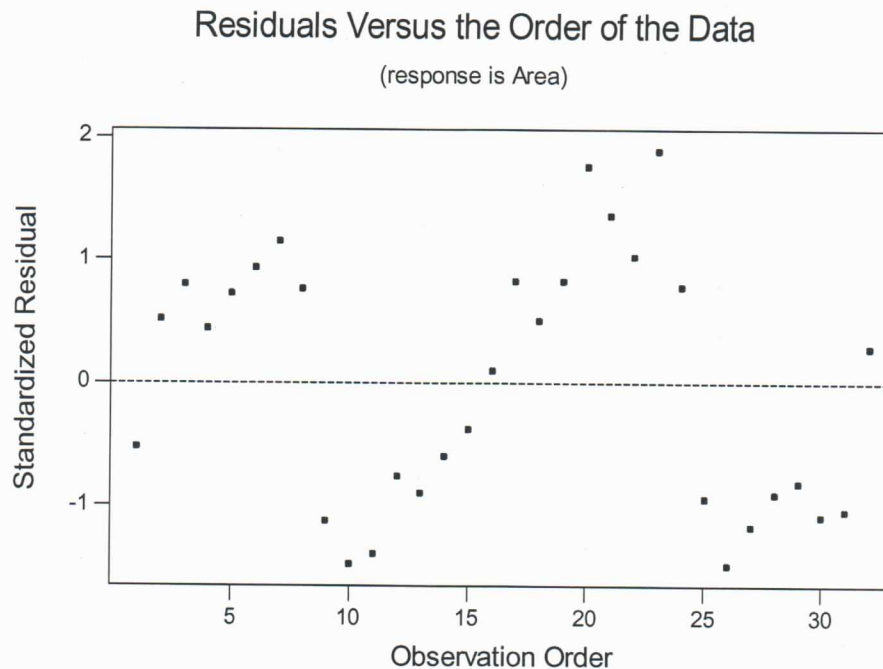
Term	Effect	Coef	SE Coef	T	P
Constant		2435.8	5.587	435.96	0.000
A	98.6	49.3	5.587	8.82	0.000
B	153.3	76.6	5.587	13.72	0.000
C	75.0	37.5	5.587	6.71	0.000
D	-573.9	-286.9	5.587	-51.36	0.000
A*C	21.1	10.6	5.587	1.89	0.210

Analysis of Variance for Length (coded units)

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Main Effects	4	2945506	2945506	736377	737.17	0.000
2-Way Interactions	1	3566	3566	3566	3.57	0.070
Residual Error	26	25972	25972	999		
Lack of Fit	10	7770	7770	777	0.68	0.726
Pure Error	16	18202	18202	1138		
Total	31	2975044				

Name _____

31. Interpret the following time order plot of residuals from a DOE. What are your recommendations?



32. What conclusions would you draw from the Minitab output below? What tool was utilized? Are there other tools that could have been utilized? Explain your response.

	N	Mean	StDev	SE Mean
Post Test	30	84.70	8.22	1.5
Pre-Test	30	81.70	8.75	1.6

Difference = μ (Post Test) - μ (Pre-Test)

Estimate for difference: 3.00000

95% CI for difference: (-1.38750, 7.38750)

T-Test of difference = 0 (vs not =): T-Value = 1.37 P-Value = 0.176

DF = 57

33. List one tool that is used to evaluate and choose one solution from several potential solutions?
34. What is the advantage of evaluating Cpk over Cp when assessing process capability?

35. List 3 measures that could be used to assess the effectiveness of a regression model?

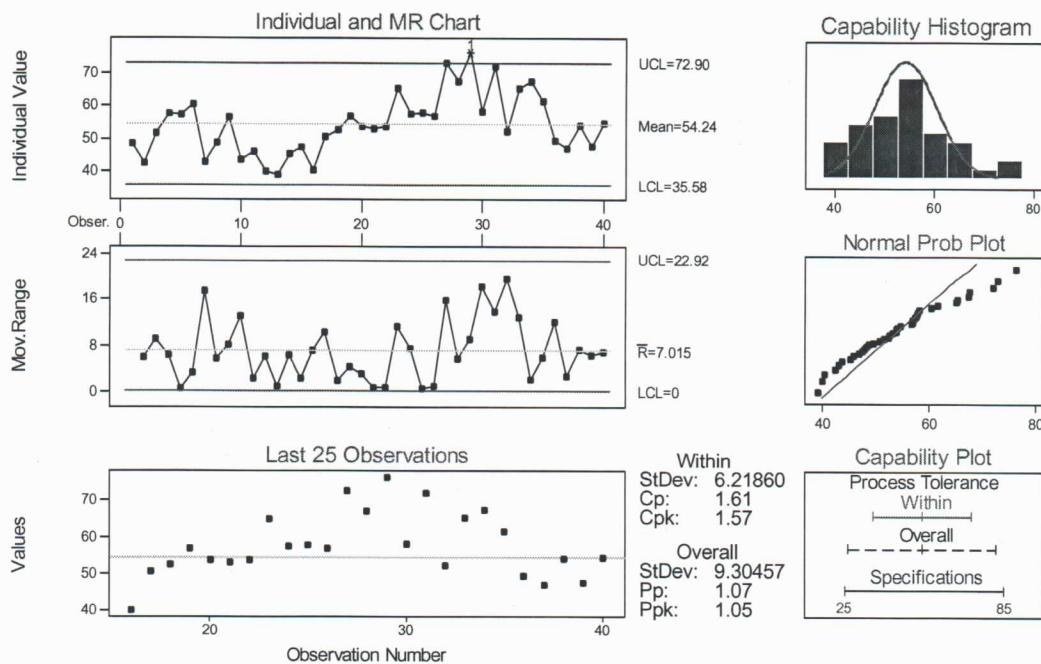
36. Under what circumstances would you use an I-MR chart instead of an Xbar-R chart?

37. Why is it important to randomize the run order when running a DOE?

38. Interpret the output from a process capability study.
Is the process in control?

Comment on the ability of the process to meet requirements.

Process Capability Sixpack for TIR

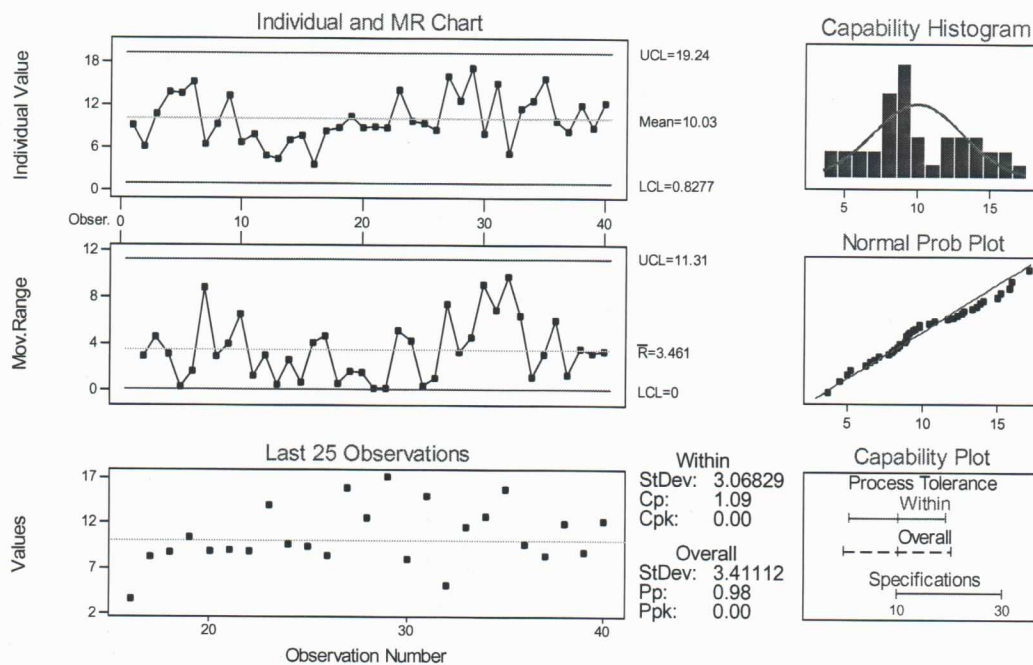


BONUS

39. Interpret the output from a process capability study.
Is the process in control?

Comment on the ability of the process to meet requirements.

Process Capability Sixpack for Clip Width



BONUS

40. An engineer has collected some *historical* data as listed below. She has expressed concern about the measurement process and has heard that you've just completed BB training. She asked for your help in analyzing these. Describe how you would use these data to estimate measurement system performance

Date	Sample(part #)	Operator	Width(response)
06/21/2000	223	Tom	116.299
06/22/2000	247	Bill	116.066
06/23/2000	271	Bill	116.47
06/24/2000	295	Tina	114.854
06/25/2000	319	Tina	116.515
06/26/2000	343	Tina	114.33
06/27/2000	367	Tom	118.204
06/28/2000	391	Bill	117.318
06/29/2000	415	Tom	113.661
06/30/2000	439	Bill	113.301
07/01/2000	463	Tina	118.092
07/02/2000	487	Bill	119.149
07/03/2000	511	Bill	117.546
07/04/2000	535	Tina	119.417
07/05/2000	559	Bill	116.748
07/06/2000	583	Tom	115.837
07/07/2000	607	Tina	121.058
07/08/2000	631	Tina	116.776
07/09/2000	655	Tina	117.16
07/10/2000	679	Bill	116.129
07/11/2000	703	Tom	114.552
07/12/2000	727	Bill	116.046
07/13/2000	751	Tina	113.62
07/14/2000	775	Tom	117.32
07/15/2000	799	Tom	116.447
07/16/2000	823	Tom	115.435
07/17/2000	847	Bill	118.638
07/18/2000	871	Tina	119.794
07/19/2000	895	Tom	116.351
07/20/2000	919	Tina	116.433
07/21/2000	943	Bill	118.442
07/22/2000	967	Tom	116.757
07/23/2000	991	Tom	118.111
07/24/2000	1015	Tom	116.338
07/25/2000	1039	Tina	117.279
07/26/2000	1063	Bill	115.537