The Lean Six Sigma Green Belt Examination

Rationale

1 U60323 - Level III – Creating Stable and Efficient Processes

B

Describe and review qualitative and quantitative data, continuous (variables) and discrete (attributes) data.

a) Incorrect. Continuous data can take any value within a range. However, qualitative data can be counted once sorted into categorical or ordinal data, it becomes discrete data that can be counted, but it cannot be measured on an infinite scale. Ref 6.2.3/4

b) Correct. Qualitative data can be categorized and the number of measurements falling into each nominal or ordinal category can be counted. This creates a quantitative comparison of attribute measurements, and is often called discrete or attribute data. Ref 6.2.3/4

c) Incorrect. Discrete data can only take certain values (like whole numbers). Discrete data is counted. However, qualitative data can be categorized and the number of measurements falling into each nominal or ordinal category can be counted. This creates a quantitative comparison of attribute measurements, and is often called discrete or attribute data. Ref 6.2.3/4

d) Incorrect. Qualitative data can be categorized and the number of measurements falling into each nominal or ordinal category can be counted. This creates a quantitative comparison of attribute measurements, and is often called discrete or attribute data. Ref 6.2.3/4

2 U30323 - Project Management

B

Apply the 'Define, Measure, Analyze, Improve and Control' (DMAIC) roadmap for Lean Six Sigma breakthrough projects. Select the proper tools to use during the Process Improvement project.

a) Incorrect. (4) The purpose of the Define phase is to clearly define the problem statement. The problem should be linked to the external customer (Voice of Customer), the organization (Voice of Business) and to other stakeholders (Voice of Stakeholder).

b) Correct. (3) Critical to Quality (CTQ) measures are determined in the Measure phase, after the Define phase. Ref 3.2.3

c) Incorrect. (2) The purpose of the Define phase is to clearly define the problem statement, the goals, the scope and the high-level project timeline.

d) Incorrect (1) The purpose of the Define phase is to clearly define the problem statement, the goals, the scope and the high-level project timeline.

3 U60412 - Level III – Creating Stable and Efficient Processes

A

Distinguish between Key Process Input variables and Key Process Output variables based on a high-level process map e.g. SIPOC (Suppliers, Inputs, Process, Outputs and Customers).

a) Correct. (4) Fed cattle are an output of the process, not an input. Ref 6.1.2
b) Incorrect. (3) This is an output of the process As a result of the feed; the cattle will eat and then fertilize the field.
c) Incorrect. (2) Collecting the feed and placing it in the troughs will be part of the process.
d) Incorrect. (1) This in an influencer on the output of the process, therefore it is an input variable

4 U30232 - Project Management

D

Understand the experience of customers linked to product features described in the range from dissatisfied, expected, satisfied and desired quality levels e.g. new KANO model.

a) Incorrect. This is a 'Must Have' or 'Must Be'. Basic needs that are taken for granted. Fulfilment of this attribute alone will not result in satisfaction, but when not fulfilled it will result in dissatisfaction.
b) Incorrect. This is not an influencer in terms of customer satisfaction with the product or service. This is a concern of the manufacturer, not the customer.
c) Incorrect. Delighters – these attributes provide satisfaction when achieved but do not cause dissatisfaction when not. These are extra benefits and beyond the customers' expectations.
d) Correct. More is better - this is called a one-dimensional quality attribute. The more is provided of this feature, the more the customer is satisfied. It can also mean 'the faster the better'. Ref 3.3.2

5 U70302 - Level IV – Creating Capable Processes

C

Select and apply control charts: Xbar-R, Xbar-S, individuals and moving range (ImR), p, np, c and u.

a) Incorrect. The C Chart also plots defects. However, the C chart plots the number of defects per sample. The C chart is useful when the subgroup size is constant.
b) Correct. The U chart plots the number of defects per unit. It is possible for a unit to have one or more defects but still be acceptable in function and performance. Ref 7.10.2
c) Incorrect. The I-MR chart is used to monitor individual measurements from a process. This chart is used if the sample that is taken from the process consists of one unit only. This means the subgroup size is 1.
d) Incorrect. This chart plots the numbers of defective products in test samples. This chart should be used when all samples are the same size and you count defectives.

6 U40311 - Level I – Creating a Solid Foundation

D

Organize the work environment by applying 5S (Sort, Straighten, Shine, Standardize, Sustain). Understand that an organized environment will improve safety and moral.

a) Incorrect. Standardize: Procedures and standards are visible. See Rationale D.
b) Incorrect. Shine: Everything is constantly kept clean. See Rationale D.
c) Incorrect. Sustain: Procedures are followed with discipline. See Rationale D.
d) Correct. After the clearing out process in the first step (Sort), the second step is to straighten. The objective of this step is to identify a permanent location for each item. It should be clear for everyone where to find an item and where to put it back in place after use. Ref 4.1.1

7 U70403 - Level IV – Creating Capable Processes

B

Interpret control charts and distinguish between common and special cause variation using rules for determining statistical control.

a) Incorrect. Control limits should only be changed if the cause of the change is known. Ref 7.10.3
b) Correct. The standard deviation of the process has decreased but no indication is given that the cause of this occurrence is known. Control limits should only be changed if the cause of the change is known. Ref 7.10.3
c) Incorrect. The occurrence indicates that the standard deviation of the measured process has reduced while no change in the mean has been noted. There is no information in the scenario regarding the customer specification. A mistake that is often made by using SPC charts is that the control limits on the SPC chart are used as specification limits. Ref 7.10.3
d) There is no information in the scenario to indicate what the target should be. There is an assumption here that the centreline is the target but it is in fact the mean of the mean of the sampled values at the time that the control limits were calculated. Ref 7.10.3

8 U60381 - Level III – Creating Stable and Efficient Processes

A

Prepare all elements of a Process Failure Modes and Effects Analysis (pFMEA), calculate the Risk Priority Number (RPN) and review the effect of FMEA results on processes, products and services.

a) Correct. An FMEA analysis resulting in a high severity rating would indicate the need to reduce the potential effect(s) of the failure. Ref 6.8.1
b) Incorrect. An FMEA analysis resulting in a high occurrence rating would indicate the need to reduce the potential cause(s) of the failure.
c) Incorrect. See Rationale A.
d) Incorrect. An FMEA analysis resulting in a high detection rating would indicate the need to improve controls and measures.

9 U10242 - World Class Performance

D

Understand that various business processes have various Key Performance Indicators (KPIs). Understand the basics of measurement systems in the organization.

a) Incorrect. 'Learning & Growth' is one of the four perspectives. Metrics referring to employee training and corporate cultural attitudes related to both individual and corporate self-improvement. Ref 1.4.2

b) Incorrect. 'Customer' is one of the four perspectives. Metrics referring to customer satisfaction, both internal and external. Ref 1.4.2

c) Incorrect. 'Financial' is one of the four perspectives. Metrics referring to financial performance, but also to non-financial performance, such as risk assessment and cost-benefit data. Ref 1.4.2

d) Correct. This is not one of the four perspectives. The fourth is 'Business Process'. This metric refers to how well the business is running and whether its products and services conform to customer requirements. Ref 1.4.2

10 U20213 - Process Improvement Deployment

D

Identify process owners, internal and external customers and other stakeholders in a project. Understand different stakeholders have different goals.

a) Incorrect. See Rationale D.

b) Incorrect. See Rationale D.

c) Incorrect. See Rationale D.

d) Correct. We need to find out the interest and influence of each stakeholder. An estimate should then be made of the relationship this stakeholder has to the project followed by the risk or opportunities for the program. A communication plan then needs to be set up that describes how you will inform and approach all stakeholders. Ref 2.1.3

11 U20323 - Process Improvement Deployment

B

Demonstrate team progress in relation to goals, objectives and other metrics. Apply techniques that motivate team members and support and sustain their participation and commitment.

a) Incorrect. This is a motivational technique. Specific feedback is more likely to apply these strengths to the next presentation if they are pointed out specifically. Ref 2.2.3

b) Correct. Most employees are not motivated by negative feedback, especially if it embarrasses them. The only acceptable place to discuss an ongoing performance-related issue or correcting a recent specific error is in privacy. Ref 2.2.3

c) Incorrect. Shared vision is a motivational technique. People are more engaged and motivated by why they do things, than what they do. A burning platform like a serious customer complaint or organizational crisis may help very well to establish one common vision and goal. Ref 2.2.3

d) Incorrect. This is a motivational technique and demonstrates belief in the employees. The perception of leaders trust is a key component of transformational leadership. Ref 2.2.3

12 U70311 - Level IV – Creating Capable Processes

A

Define and describe various CTx requirements Critical to Quality (CTQ), Cost (CTC), Process (CTP), Safety (CTS) and Delivery (CTD)) and the importance of aligning projects with those requirements.

a) Correct. The ‘’Voice of the Customer’ (VOC) requirements are often expressed in an unclear manner. The task is to interpret this into an unambiguous and measureable specification of the requirement. This metric is called the external Critical to Quality (CTQ). Projects are often linked to a particular area. Therefore the CTQ is sometimes called Critical to Safety (CTS), Critical to Process (CTP), etc. Ref 7.1.1

b) Incorrect. This is a VOC requirement. This is not measurable. Ref 7.1.1

c) Incorrect. This is not measurable. Ref 7.1.1

d) Incorrect. This is an internal CTQ for the company manufacturing the new system. Adherence to this CTQint will be a foundation for achieving the CTS. Ref 7.1.2

13 U10231 - World Class Performance

D

Understand the value of Lean and Six Sigma, its philosophy and goals.
Describe the relationship between Lean and Six Sigma.

a) Incorrect. Both share this principle.

b) Incorrect. Both share this requirement.

c) Incorrect. Both share this principle.

d) Correct. Both Lean and Six Sigma have a strong foundation of improving customer value. Both seek to achieve improved effectiveness and process quality by reducing variation. Both require the commitment of staff and management. Neither refers to a long learning curve. Ref 1.3.1.

14 U70321 - Level IV – Creating Capable Processes

A

Calculate Six Sigma process performance metrics e.g. Parts per Million (ppm), Defects per Million Opportunities (DPMO), Defects per Unit (DPU) and Rolled Throughput Yield (RTY). Understand the difference between a defect and a defective.

a) Correct. The Rolled Throughput Yield (RTY) is calculated by multiplying the First Time Right (FTR%) of each process step in the sequence. Only those products that were correct, without defect, not reworked are considered. Step A FTR% = 76/86 = 0.884, Step B FTR% = 88/96 = 0.917, Step C FTR% = 73/80 = 0.912. RTY = 0.884 * 0.917 * 0.913 = 0.74 = 75% Ref 7.2.1

b) Incorrect. See Rationale A.

c) Incorrect. See Rationale A.

d) Incorrect. See Rationale A.

15 U70343 - Level IV – Creating Capable Processes

A

Understand the Central Limit Theorem (CLT).

a) Correct. A large number, n, of mutually independent and equally distributed random variables will approach a normal distribution when 'n' increases. The variables themselves do not need to have a normal distribution. Ref 7.4.3

b) Incorrect. See Rationale A

c) Incorrect. Defectives are discrete while the normal distribution is continuous Ref 7.4.1/7.4.2

d) Incorrect. Confidence intervals are based on a the distribution of the data Ref 7.6.2

16 U30212 - Project Management

D

Understand the basic principles of team formation and team member selection.

a) Incorrect. Team members are usually subject matter experts in the part of the process they undertake every day.

b) Incorrect. It is the Green Belt team leader, not the team member who must have some knowledge of statistical analysis.

c) Incorrect. Team members are rarely full time on team projects.

d) Correct. Teamwork means that people will cooperate, using their individual skills and providing constructive feedback, despite any conflict between individuals. Team members need to be able to listen to other people both in the team meetings and outside in the workplace. Ref 3.1.2

17 U60332 - Level III – Creating Stable and Efficient Processes

A

Apply Value Stream Mapping (VSM) to construct a Current State Map of the process to identify waste and non-value added activities.

a) Correct. The transfer of data electronically removes the 'Waste' of 2 minutes where the wait staff are currently walking the order to the kitchen. Ref. 6.3.2

b) Incorrect. The pizza still takes 6 minutes to cook. This will help with process flow without building up inventory that must wait for oven space, but it will not reduce the Cycle Time.

c) Incorrect. Currently a push system connects the freshly made pizza base to the topping area. Creating a readymade supply of bases does not remove the Cycle Time necessary for creating the bases. This time is now spent outside of what goes into the lead time, or the wait time that the customer experiences.

d) Incorrect. This will reduce inventory but it will not reduce the Cycle Time. It still takes the same amount of time from order to delivery.

18 U50331 - Level II – Creating a Continuous Improvement Culture
D
Apply brainstorm techniques: Affinity diagram, 5-Why's and Ishikawa.

a) Incorrect. (4) See Rationale B.
b) Incorrect. (3) The second phase of summarizing involves sharing, capturing and grouping ideas, and simultaneously encourages the synergetic process that produces innovative spin off ideas. Ref 5.3.1
c) Incorrect. (2) A two-phased approach starts with individuals noting their own ideas silently, without influence from others. Ref 5.3.1
d) Correct. (1) Senior members of the team or dominant individuals can lead a team down a single train of thought. It is advisable to start with an open phase, allow individuals to brainstorm individually before sharing and capturing ideas. Ref 5.3.1

19 U70331 - Level IV – Creating Capable Processes
A
Calculate population parameters and sample statistics e.g. proportion, mean and standard deviation.

a) Correct. First sequence the numbers in numerical order. The Range is the absolute difference between maximum and minimum value of a data set. In this case 2 and 9, the difference is 7. Ref 7.3.1
b) Incorrect. See Rationale A.
c) Incorrect. See Rationale A.
d) Incorrect. See Rationale A.

20 U50422 - Level II – Creating a Continuous Improvement Culture
D
Apply and analyze the outcome of basic quality tools: Check sheet, Pareto chart, Scatter plot, Bar chart, Pie chart, Time Series plot, Histogram and Box plot.

a) Incorrect. The chart shows that cumulatively 95% of all defects can be removed by solving these four issues. Ref 5.2.2
b) Incorrect. This is the rule shown by the Pareto chart. It shows the single most important factor among a set of factors. Ref 5.2.2
c) Incorrect. The chart does show that 'Dirt' is singularly the most frequently occurring defect. The cumulative percentage shows that 58% of all defects can be resolved by fixing the 'Dirt' issue. Ref 5.2.2
d) Correct. The Pareto chart shows that 'Dirt' is singularly the most frequently occurring defect. Ref 5.2.2

21 U80222 - Level V – Creating World Class Products

C

Describe the difference between the DMAIC roadmap and DfSS roadmap (e.g. DMADV).

a) Incorrect. 'Measurement Systems Analysis' (MSA) is a tool used by both DMADV and DMAIC, it is not a roadmap

b) Incorrect. The DMAIC roadmap is used for improving, optimizing and stabilizing existing business processes and products. Ref. 3.2.3

c) Correct. This roadmap is applied to problem prevention, development and innovation projects. Ref 8.2.2.

d) Incorrect. 'Design of Experiments' (DOE) is a tool used by both DMADV and DMAIC, it is not a roadmap.

22 U60253 - Level III – Creating Stable and Efficient Processes

C

Understand the eight pillars of Total Product Maintenance (TPM) and understand how it can be used for process improvement.

a) Incorrect. See Rationale D.

b) Incorrect. See Rationale D.

c) Correct. TPM focuses on the effective and efficient use of equipment, by avoiding breakdowns, delays and machine-related rejections. Ref 6.5.3

d) Incorrect. This is a reactive solution, to deal with problems when they arise. Improving availability requires fewer breakdowns, delays and machine-related rejections. Ref 6.5.3

23 U60361 - Level III – Creating Stable and Efficient Processes

A

Describe the importance of Pull for reducing Mura. Implement Pull in the organization by applying Kanban systems.

a) Correct. It does not follow that an order for further products is required each time a withdrawal is made from stock. This means the stock levels of raw materials, components, work in progress and finished goods are kept to a minimum. Ref 6.6.1

b) Incorrect. Working according to Pull instead of Push will avoid inventory and overproduction. It is necessary to work according to the 'Just in Time' principle.

c) Incorrect. See Rationale B.

d) Incorrect. The Pull principle ensures each operation step is supplied with the right part, at the right time, in the right amount. The Kanban card will specify the amount of product required. It is not for the warehouse person to forecast requirements.

24 U30222 - Project Management

D

Understand the Eight Disciplines (8D) Problem Solving method used to approach and resolve problems.

a) Incorrect. See Rationale D.
b) Incorrect. See Rationale D.
c) Incorrect. See Rationale D.
d) Correct. It is also a communication technique. A customer can ask a supplier to conduct an 8D investigation when faced with a problem. Because the steps in the method are defined, it is clear to the supplier what is expected. During the problem solving method, the customer and supplier can communicate about expectations and progress with certain steps. Ref 3.2.2

25 U70391 - Level IV – Creating Capable Processes

A

Understand the limitations of One-Factor-At-a-Time (OFAT) experiments. Understand why Design of Experiments (DOE) is a more efficient way of experimenting. Apply DOE principles and terms: responses, factors, levels, transfer function, run order, randomization, balanced designs, residual error, main effects, interaction effects, replicates and repetitions.

a) Correct. (4) The One-Factor-At-a-Time approach, although very popular and intuitive, is not an effective way to solve issues unless you are dealing with a very simple problem, It is always better to perform a design of experiments (DOE) rather than change parameters One Factor at a Time. Changing one factor at a time will never allow you to identify interactions, but DOE will. Ref 7.9.1
b) Incorrect. (3) See Rationale A.
c) Incorrect. (2) See Rationale A.
d) Incorrect. (1) See Rationale A.

26 U10211 - World Class Performance

B

Understand the three competitive strategies. Understand how Operational Excellence can be applied in different types of enterprises e.g. manufacturing, service, transactional, product and process design, innovation.

a) Incorrect. This strategy focuses on offering a unique service or product to the market. This requires the personalization of services and customization of products to meet the needs of an individual customer.
b) Correct. This strategy focuses on delivering to customer expectations, without failure, on time and in a cost-efficient manner. It is a philosophy where problem solving, teamwork and leadership result in the on-going improvement of the organization. Ref 1.1.1
c) Incorrect. This strategy focuses on continuously offering superior products to the market. Product leaders achieve premium market prices thanks to the experience they create for their customers.
d) Incorrect. There are three generic competitive strategies: Operational Excellence, Customer Intimacy and Product Leadership.

27 U70384 - Level IV – Creating Capable Processes

C

Calculate and interpret process performance indices: Pp and Ppk. Interpret the relationship between capability and performance indices.

a) Incorrect. The 1.5 standard deviation shift is an assumption used to achieve processes that cause no more than 3.4 DPMO in the long term. In reality the amount of shift or drift that occurs over time will be different for every process. Ref 7.8.3

b) Incorrect. See Rationale C.

c) Correct . Cp is equal to tolerance divided by σwithin (Ref 7.8.2). Pp is equal to tolerance divided by σoverall (Ref 7.8.4). Process performance is based on the total variation of a process in the long term. Since a process is seldom perfectly stable, its mean will drift in time and the standard deviation may vary in time too (Ref 7.8.1). Therefore σoverall will be larger than σwithin and consequently Pp will be smaller than Cp. Ref Maths Furthermore Ppk will always be less than Pp and thus Ppk must also be smaller than Cp. Ref 7.8.4

d) Incorrect. See Rationale C

28 U60422 - Level III – Creating Stable and Efficient Processes

C

Analyze Lean performance metrics e.g. Takt Time, Cycle Time, Lead Time, queue time, Work in Process (WIP), yield and Overall Equipment Effectiveness (OEE).

a) Incorrect. See Rationale C.

b) Incorrect. See Rationale C.

c) Correct. The OEE is calculated by multiplying the Availability Rate x Performance Rate x Quality Rate. Ref 6.2.2

d) Incorrect. This is the Availability Rate. Calculated as the production time/loading time. Ref 6.2.2

29 U70312 - Level IV – Creating Capable Processes

B

Translate the Voice of Customer (VOC) into external Critical to Quality (CTQ) and internal CTQ's. Construct a CTQ Flowdown that represents the key measurable characteristics of a product or process whose performance standards or specification limits must be met.

a) Incorrect. This price range is measureable, and therefore a suitable Critical to Quality metric.

b) Correct. A CTQ Flowdown represents the key measurable characteristics of a product whose performance standards or specification limits must be met in order to satisfy the customer requirement. The terms tasty and pleasant need surveying on a scale of say 1-10, with 8 being the target? Ref 7.1.2

c) Incorrect. See Rationale B.

d) Incorrect. The effort of decomposing the VOC to a lower level should focus on responses and not on defining the factors of influence.

30 U70254 - Level IV – Creating Capable Processes

B

Describe elements of metrology, including calibration systems, traceability to reference standards, the control and integrity of standards and measurement devices.

a) Incorrect. (4) Traceability to reference standards. Standards like mass, time, length are defined in relationship to internationally standardized reference objects.
b) Correct. (3) This is meteorology, best known for use in weather forecasting. Ref 7.5.4
c) Incorrect. (2) System calibration is the process of determining and adjusting an instrument's accuracy to make sure it is within specification.
d) Incorrect. (1) See Rationale C.

31 U60382 - Level III – Creating Stable and Efficient Processes

B

Prepare a control plan to document and hold gains. Define controls and monitoring systems. Transfer of responsibility from the project team to the process owner.

a) Incorrect. See Rationale B.
b) Correct. The Control plan, sometimes called the inspection plan, comprises actions that should be performed to minimize or mitigate the potential failures as identified in the Failure Modes and Effects Analysis (FMEA). If safety is important to the customer, then this is Critical to Quality (CTQ). It should be monitored. Ref 6.8.2
c) Incorrect. See Rationale B.
d) Incorrect. See Rationale B.

32 U80211 - Level V – Creating World Class Products

C

Understand the lifecycle for products from creation, engineering, manufacturing to service and disposal.

a) Incorrect. See Rationale C.
b) Incorrect. See Rationale C.
c) Correct. Product Lifecycle Management is the process of managing the entire lifecycle of products. A product it most costly when moving from development to growth. The peak of its profitability is when it reaches maturity. Ref 8.1.1
d) Incorrect. See Rationale C.

33 U60431 - Level III – Creating Stable and Efficient Processes
C
Distinguish Value Added from Non-Value Added Activities.

a) Incorrect. See Rationale C.
b) Incorrect. See Rationale C.
c) Correct. A Value Adding Activity must meet the following criteria: The customer is willing to pay for the activity, it must be done correctly the first time (First Time Right) and the action must change the product or service in some way. Ref 6.3.1
d) Incorrect. See Rationale C.

34 U70392 - Level IV – Creating Capable Processes
D
Plan, organize and apply experiments by determining the objective, selecting factors and responses.

a) Incorrect. Time is a factor.
b) Incorrect. Power settings are a factor.
c) Incorrect. There are two brands. This is a factor.
d) Correct. This is a constraint rather than a factor. Ref 7.9.2

35 U50314 - Level II – Creating a Continuous Improvement Culture
B
Facilitate improvement teams and Kaizen events.

a) Incorrect. A typical Kaizen Blitz takes a few days to a week to carry out and is led by a facilitator. It is about getting things done immediately, not about making weeks of analysis and then taking a few more weeks to implement the solution. Ref 5.1.4
b) Correct. The customer should always be the starting point of improvement projects. This not only concerns the external customer, but also the internal customer. Each step in the process has a customer who receives the outcome of its process steps. Therefore it is important that each process step is treated like a customer. Ref 5.1 4
c) Incorrect. See Rationales A and B.
d) Incorrect. See Rationales A and B.

36 U60363 - Level III – Creating Stable and Efficient Processes

C

Reduce change over times by implementing Single Minute Exchange of Die (SMED).

a) Incorrect. See Rationale C.
b) Incorrect. See Rationale C.
c) Correct. The SMED approach incorporates an eight-step approach, this includes eliminating adjustment activities and removing any external activities like preparation and cleaning that can be done while the machine is still running. Ref 6.6.3
d) Incorrect. See Rationale C.

37 U10221 - World Class Performance

D

Understand the origin of Total Quality Management (TQM), Lean and Six Sigma.

a) Incorrect. Fisher was an English statistician. According to some he created the foundations for modern statistical science. One of the important contributions to statistics includes the Analysis of Variance (ANOVA) and Design of Experiments (DOE).
b) Incorrect. Deming was a statistician after whom the Deming Prize for quality is named (1951).
c) Incorrect. Juran was a management consultant and engineer. He wrote several influential books on quality management. He was one of the first to write about the Cost of Poor Quality (COPQ).
d) Correct: Walter Andrew Shewhart (1891-1967) was known as the father of statistical quality control. He has set the basis for the control chart and bringing the production process into a state of Statistical Process Control (SPC). Ref 1.2.1 / 7.10.1

38 U70393 - Level IV – Creating Capable Processes

B

Design and analyze Full Factorial experiments. Understand the meaning of contrast.

a) Incorrect. The p-value for main effect C is 0.063 is not significant at the 5% level Ref 7.9.3
b) Correct. The p-values for main effects A,B and D and interaction B*D are all less than 0.05 and therefore significant at the 5% level. Ref 7.9.3
c) Incorrect. The p-values for main effects A,B and D are all less than 0.05 and therefore significant at the 5% level. Additionally the p-value for interaction A*C is 0.492 and is not significant at the 5% level. Ref 7.9.3
d) Incorrect. The p-values for the model is less than 0.05 and is therefore significant at the 5% level. This means we can make conclusions with 95% confidence. Ref 7.9.3

39 U50413 - Level II – Creating a Continuous Improvement Culture

D

Define and apply Root Cause Analysis (RCA), recognize the issues involved in identifying a root cause. Apply problem solving process and tools.

a) Incorrect. Blue 'screen of death' or 'continuous reboots' is a Symptom: A characteristic or complaint belonging to a specific problem. Ref 5.1.3

b) Incorrect. People do make mistakes, but Poka Yoke does not always prevent the mistake; it may just highlight it once it has happened. Ref 5.3.1

c) Incorrect. It is also not strictly necessary to ask exactly five times 'Why?' to each question. Ref 5.3.1

d) Correct. The 5-whys have to answer three questions; why did the problem occur, why it was only detected by the client, and why did the 'system' not function? Ref 5.3.1

40 U70381 - Level IV – Creating Capable Processes

C

Apply capability studies, including identifying characteristics and specifications. Prepare sampling plans to verify stability.

a) Correct. (4) Performing a Z-transformation will not produce a normal distribution unless the original distribution was already normal. Ref 7.8.1

b) Incorrect. (3) Using a Box-Cox transformation would be a classic approach to deal with non-normal data. Ref 7.8.1

c) Incorrect. (2) Identifying the non- normal distribution would be a classic approach to deal with non-normal data. Ref 7.8.1

d) Incorrect. (1) Reporting the Capability of each sub-group would be a legitimate approach. Ref 7.8.1

41 U70432 - Level IV – Creating Capable Processes

A

Evaluate special cause and common cause variation.

a) Correct. Typical performance level is between 10 - 15 minutes. This allows for traffic. Anything outside of this would be a special cause variation.

b) Incorrect. Typical performance level is between 10 - 15 minutes. This allows for traffic. Anything outside of this would be a special cause variation.

c) Incorrect. Being outside of the normal levels makes this event a special cause variation rather than a common cause variation.

d) Incorrect. Typical performance level is between 10-15 minutes. This allows for traffic, etc. Anything outside of this would be a special cause variation. If the upper and lower limits of 10 - 15 minutes were to need improving, then the bicycles could be a solution.

42 U60254 - Level III – Creating Stable and Efficient Processes
C
Describe how competence management supports the reduction of Muri.

a) Incorrect. This is not a use of a skill matrix.
b) Incorrect. This is not a use of a skill matrix, but may perhaps be recorded as lessons learned for future projects.
c) Correct. A competence management skill matrix identifies five levels of skills from cannot perform a task' to 'can teach others to perform. Its aim is to ensure that each person is able to perform three tasks and each operation should be mastered by three people. This will prevent a roadblock; help support the reduction of Muri for work levelling. Ref 6.5.4
d) Incorrect. This is not a use of a skill matrix.

43 U70371 - Level IV – Creating Capable Processes
B
Calculate and interpret the correlation coefficient. Determine its statistical significance (p-value) and recognize the difference between correlation and causation.

a) Incorrect. See Rationale B
b) Correct. Practically, a well-designed experiment should be performed where the joint variation of two measurements are observed while keeping all other variable same. Correlation could then indicate causation. Ref 7.7.1
c) Incorrect. A hypergeometric distribution is a discrete distribution Ref 7.4.2. Correlation Analysis studies the degree of correlation between two continuous variables. Ref 7.7.1
d) Incorrect. See Rationale B

44 U30255 - Project Management
B
Identify and document lessons learned from all phases of a project. Identify possible improvements and ownership.

a) Incorrect. (4) There is no predefined way of defining lessons learned. Defining and documenting lessons learned can make all the difference on future projects and help them to succeed. Ref 3.5.5
b) Correct. (3) This is a question that should be asked prior to initiating an improvement project, not when completing one. Ref 3.5.5
c) Incorrect. (2) See Rationale A.
d) Incorrect. (1) See Rationale A.

45 U60362 - Level III – Creating Stable and Efficient Processes

B

Implement a balanced process flow by both Volume leveling, Type leveling and One Piece Flow.

a) Incorrect. See Rationale B.

b) Correct. There are 95 hours x 60 minutes = 5700 minutes of production time. The rate determining step in the process is Step 3. The very first product produced will pass through Step 1 and 2 taking 20 + 30 = 50 minutes to reach Step 3. That leaves 5700 – 50 = 5650 minutes for Step 3: 50 minutes, to produce 5650 / 50 minutes = 113 units. Ref 6.6.2

c) Incorrect. See Rationale B.

d) Incorrect. See Rationale B.

46 U30344 - Project Management

C

Select financial measures and Cost of Poor Quality (COPQ). Calculate the hard benefits of the project and describe the soft benefits of the project.

a) Incorrect. (4) Soft benefits are those that cannot be solely attributed to the training program and/or cannot be readily assigned a specific financial value.

b) Incorrect. (3) See Rationale A.

c) Correct. (2) Benefits can be broken down into hard and soft benefits. Hard benefits are those that can be attributed solely to the training program and can be assigned a specific value. Ref 3.4.4

d) Incorrect. (1) See Rationale A.

47 U70372 - Level IV – Creating Capable Processes

A

Apply linear regression analysis. Use the regression model for estimation and prediction. Interpret the residual analysis to validate the model.

a) Correct. The p-value for the regression is 0.043 indicating that the model is significant. The R-sq value indicates that only 41.8% of the variance is explained by this model and you should look for additional predictors. Ref 7.7.2

b) Incorrect. See Rationale A

c) Incorrect. The p-value for the regression is 0.043 indicating that the model is significant. Ref 7.7.2

d) Incorrect. The p-value for the regression is 0.043 indicating that the model is significant. Ref 7.7.2

48 U60421 - Level III – Creating Stable and Efficient Processes

A

Analyze process flow and utilization. Apply Little's Law.

a) Correct. According to Little's Law, the average Lead Time is calculated as Work In Process (WIP) / Completion Rate. To produce 50 crates containing 24 bottles of 0.3 litres = 360 litres. If 100 litres can be produced in a day, it will take more than 3 days (3.6) to produce 360 litres. Ref 6.2.1

b) Incorrect. See Rationale A.

c) Incorrect. 'Just In Time' (JIT) working removes the need for stock of finished goods or raw materials.

d) Incorrect. See Rationale A.

49 U10251 - World Class Performance

C

Understand financial measures, including Costs of Poor Quality (COPQ) and Return on Investment (ROI).

a) Incorrect. Centring the mean is a monitoring activity, used for monitoring process variation and detecting the presence of special causes. Ref 7.10.2

b) Incorrect. Reducing variation will reduce the cost of production rather than increase it.

c) Correct. Conformance costs relate to quality planning. This includes systems and procedures to prevent things going wrong like design reviews, in-process controls, employee training, etc. Whilst beneficial, they are still actually costs related to quality and as such classified under Cost of Poor Quality (COPQ). Ref 1.5.1

d) Incorrect. This will reduce the cost of production. Preventing defective products being produced will not increase the cost of production.

50 U60441 - Level III – Creating Stable and Efficient Processes

C

Identify and analyze the 8 types of Operational Waste (Muda): Overproduction, Waiting, Transport, Over-processing, Inventory, Movement, Defects, Unused expertize.

a) Incorrect. Mandated inspections are considered to be necessary activities. They are neither Value Adding, nor Non-Value Adding.

b) Incorrect. The inspections that the customer is not willing to pay for are considered to be Non-Value Adding activities and therefore waste. However, some inspections are mandated and are therefore necessary activities.

c) Correct. Over-processing occurs any time that work is done to the product for which the customer is not willing to pay. Measuring quality and inspection is classified as 'Over-processing' as long as the measurement is used for verification only, and not used to adjust or improve the quality of the product. Ref 6.4.1

d) Incorrect. It is Waste because inspection does not change the product and therefore does not add value.

51 U70363 - Level IV – Creating Capable Processes

A

Calculate sample size for common hypothesis tests.

Correct. The '1-Sample Z' test can be used.

Sample size

$$n = \frac{\sigma^2 \cdot (Z_{1-\alpha} + Z_{1-\beta})^2}{\delta^2}$$

n = 5^2*(1.28 + 1.64)^2/ 6^2 = 5.9

which must be rounded up to 6. Ref 7.6.3/7.6.4

a)

b) Incorrect. See rationale A.

c) Incorrect. See rationale A.

d) Incorrect. See rationale A.

52 U20211 - Process Improvement Deployment

A

Understand there are various techniques for facilitating management of change. Understand the impact an organization's culture and inherent structure can have on the success of Lean Six Sigma.

a) Correct. This affects the collective way of thinking and working by people in the organization and determines the standards and values of an organization. A major reason why a process of change is difficult is because the organizational culture, and the structure in which it is embedded, often reflect the imprint of earlier periods in a persistent way. Ref 2.1.1

b) Incorrect. See Rationale A.

c) Incorrect. See Rationale A.

d) Incorrect. See Rationale A.

53 U70361 - Level IV – Creating Capable Processes

D

Define and interpret the significance level, power, Type I and Type II errors in statistical tests.

a) Incorrect. This would be a correct judgement as the batch is non-conforming (rejecting the defective products).

b) Incorrect. This would be a correct judgement as the batch is conforming.

c) Incorrect. This is a Type II Error. Not supporting the alternate hypothesis when the alternate hypothesis is true.

d) Correct. This is a Type I Error. Supporting the alternate hypothesis when the null hypothesis is true. Ref 7.6.1

54 U30211 - Project Management

D

Describe Lean Six Sigma levels of expertize: Master Black Belt, Black Belt, Green Belt, Orange Belt and Yellow Belt. Describe various team roles and responsibilities: Deployment leader, Champion, Project leader, Coach, and Team member.

a) Incorrect. See Rationale D.
b) Incorrect. See Rationale D.
c) Incorrect. See Rationale D.
d) Correct. The Champion is the sponsor of Lean Six Sigma projects. Ref 3.1.1

55 U70352 - Level IV – Creating Capable Processes

A

Apply measurement systems for continuous data. Interpret Repeatability and Reproducibility (R&R), stability, bias, linearity, precision to tolerance and number of distinct categories.

a) Correct. The difference between the measured average and the true value. (Bias = Observed Average – True Value). Bias = 0.75 – 0.80 = -0.05. Ref 7.5.2
b) Incorrect. See Rationale A.
c) Incorrect. See Rationale A.
d) Incorrect. See Rationale A.

56 U30352 - Project Management

C

Apply project planning tools such as Gantt charts, Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT) charts. Apply basic disciplines of time management e.g. attending meetings, arriving on-time, coming prepared, being punctual and to the point.

a) Incorrect. See rationale C.
b) Incorrect. See rationale C.
c) Correct. Total float is defined as latest start time – earliest start time. Ref 3.5.2
d) Incorrect. See rationale C.

57 U70342 - Level IV – Creating Capable Processes

A

Interpret discrete distributions: Poisson and Binomial.

a) Correct. (4) This would require a Poisson Distribution. An infinite number of trials within a unit of time with unlimited number of possible outcomes. Ref 7.4.2
b) Incorrect. (3) See Rationale D.
c) Incorrect. (3) See Rationale D.
d) Incorrect. (1) This can be assessed using a Binomial distribution. A fixed number of trials, with only two possible outcomes (pass or fail), within a set number of trials. Ref 7.4.2

58 U40321 - Level I – Creating a Solid Foundation

C

Standardize tasks and processes to establish the foundation for continuous improvement and employee empowerment. Prepare documents, Standard Operating Procedures (SOPs) and One Point Lessons to ensure that the improvements are sustained over time.

a) Incorrect. The SOP describes what tools are required and the sequence of the process activities.
b) Incorrect. The SOP defines who is trained and permitted to operate the process and how many employees are required to operate the process.
c) Correct. Ensuring the SOP is followed consistently over time is crucial. Establishing an evaluation and review system will ascertain that over time all the steps of a SOP are still relevant and appropriate for the production system. This is not part of the SOP itself. Ref 4.2.1
d) Incorrect. The SOP includes how often products are retrieved from the work cell and how they should be packed or stored.

59 U60371 - Level III – Creating Stable and Efficient Processes

B

Define the gap between the current state and the target condition. Define a Future State Map using Value Stream Mapping (VSM). Apply techniques to reduce Muda, Mura and Muri.

a) Incorrect. See Rationale B.
b) Correct. If only one unit is created at any one time, the average Lead Time needs to take account of the yield %. Step A has an 80% yield. This means that a further 20% need to be produced to ensure a 'good product'. Therefore step A becomes 20% longer, or 5 minutes. Step B is 100% already. Step C needs another 5% so this step becomes 10 minutes. So step A (5 minutes) + step B (5 minutes) + step C (10 minutes) is 20 minutes total Lead Time. Ref 6.7.1
c) Incorrect. See Rationale B.
d) Incorrect. See Rationale B.

60 U30442 - Project Management

B

Develop and review project boundaries to ensure that the project has value to the customer (scope). Develop the objectives and measurable targets for the project based on the problem statement and scope (goal).

a) Incorrect. (4) In the Lean Six Sigma quality methodology, process capability and process performance lead to a better understanding of the cause of variation.
b) Correct. (3) Lean Six Sigma projects are focusing on solving problems and not on implementing known solutions, for example buying a new piece of equipment. Ref 3.4.1/2
c) Incorrect. (2) Analysis of the process would highlight measurements that are clearly outside the natural behaviour of the process 'outliers'. Within Lean Six Sigma projects these improvement initiatives can be classified as 'low -hanging fruit' projects.
d) Incorrect. (1) The less variation a process has, the better we can predict its outcome. Lean Six Sigma has a strong focus on reducing variation.