BQF Lean Six Sigma Certification Process

The **Lean Six Sigma certification** process is designed to evaluate competencies in the following areas:

1. Leadership
2. Change Management
3. Team Working
4. Project Management
5. Lateral Thinking
6. Lean and Six Sigma tools
7. Statistical and analytical tools
8. Problem Solving Skills
9. Contribution to the overall deployment programme

Body of Knowledge

The Lean Six Sigma Academy has detailed a Body of Knowledge for both **Green** and **Black Belts** to indicate the typical training content and expected level of understanding for both applicants and certifying organisations.

Certification Steps

The process has four steps which follow the same pattern for candidates at both Green and Black Belt level, with the latter reflecting the greater detail, complexity and application required to reach that level.

Step 1 – Examination

Examinations take place following training and are open book. The Green Belt exam consists of short answer, multiple choice questions focusing on concepts and simple tools of DMAIC improvement projects. The Black Belt exam is designed to additionally test statistical analytical and change management knowledge.

Step 2 –Assessment of completed project/s

Following the exam, the candidate is expected to submit storyboards of successfully completed projects for review.

Green Belt candidates are expected to submit one completed DMAIC project storyboard while Black Belt candidates need to provide at least two completed projects.

Master Black Belt candidates are expected to be able to demonstrate all the above as well as comprehensive implementation experience as well as training and mentoring expertise.

Step 3 – Interview

The candidate undergoes a 1-2 hour interview by the examiner to review the project/s submitted and to test the softer issues around leadership, change management and general understanding of Lean Six Sigma tools and concepts.

Step 4 - Feedback and recognition

Each candidate will receive a written feedback report covering their performance across all the certification criteria. Candidates who do not pass the exam/interview process will be offered further support to strengthen any weaker areas. Successful candidates also receive an official certificate and are added to our **Certification Register**.

Lean Six Sigma Green Belt ~~certification~~ Body of Knowledge

The **Green Belt Body of Knowledge** indicates the typical training content and expected level of understanding for both applicants and certifying organisations.

Understanding of Lean Six Sigma:

☐ The Key Principles of Lean and Six Sigma.

☐ The different methodologies: DMAIC (Process Improvement), DMADV (Design For Six Sigma), rapid improvement events and when to use each.

☐ Roles of the Project Champion, Yellow Belt, Green Belt, Black Belt and Master Black Belt.

☐ Use of Tollgate reviews and storyboards to manage a project.

☐ Use of financial benefit analysis to gain support for change.

☐ Gaining commitment - does and don'ts.

☐ Managing change and the need for soft tools to get buy-in.

☐ The need for a systematic approach - clear understanding and application of the DMAIC methodology.

☐ Leading an Improvement Project Team

Define

☐ Project selection

☐ Project Charter including:
o Business case

o Problem and Goal statements

o Scope

o Project Milestones

o Team Roles and Responsibilities

 Stakeholder Analysis

 Communciations Plan

 SIPOC

 Gathering voice of the Customer and generating CTQ statements

 Project Risk Analysis

Measure

 As Is Process mapping.

 Spaghetti diagrams, process stapling, Functional deployment maps (Swim lane) and Value Stream Maps

 Types of data.

 Gathering the right data throughout the process; Understanding Output and Input process data.

 Sampling from populations and processes

 Developing a measurement plan including operational definitions and Sampling and sample size calculations.

 Measurement systems analysis (concepts of Gauge R&R and Attribute Agreement Analysis),

 Understanding Variation

 SPC basics including identification of common and special cause process variation and why it matters.
o Sources of variation; PEMME or similar

o How to construct control charts; XmR and X bar-R

o Awareness of other SPC charts
 Calculation of baseline performance and process sigma using DPMO

 Process capability (simple Cp and Cpk)

Analyse

 Process value added analysis,

 Cause and effect analysis; 5 Whys + fishbone diagram or similar

 7 process Wastes / Muda

 Graphical analysis and Segmentation (Stratification) including histograms, pareto charts and scatter plots

 Identification and Verification of Root Causes using tools such as:
o Correlation and regression analysis - awareness

- Hypothesis testing – awareness

- Design of Experiments (DoE) – awareness

- Logical Cause Matrix
- Financial assessment of root causes – Quantified Opportunity

Improve
- Ideas generation - Brainstorming and creativity techniques

- Enabling processes to flow; push vs pull processes

- Reducing process set up or changeover time

- Organising work areas and standardising practices; 5S

- Achieving the customers requirements; Takt Time

- Removing process constraints; theory of constraints or similar

- Creating the future state process map

- Prioritisation matrix and other selection techniques (N/3 and paired comparison or equivalent)

- FMEA and error proofing (Poka Yoke)

- Project planning (7 New Tools or equivalent) and piloting

- Force field analysis,

- Cost benefit analysis

Control
- Standardisation and documentation

- Process Improvement implementation including Control plan, training plan, communications and implementation plan

- Visual Management

- Process Response plan

- Using Control Charts in the control phase to:
- Assess impact of improvement

- Understand current performance

- Monitor future performance
- Project handover and ownership

- Sustaining the gains through Process Management.

Note: There is no requirement for Green Belts to be able
to use specific statistical software such as Minitab, nor to understand the advanced
statistical concepts that underpin it. Hence topics such as hypothesis tests, regression
analysis and DoE are required at the awareness level only so the candidate should be
aware that these tools exist, when it might be prudent to ask for Black Belt help in running
them and sufficient understanding of the concepts and jargon to be able to define what
they need and to understand the results the Black Belt gives them.

Lean Six Sigma Black Belt Body of Knowledge

The **Black Belt Body of Knowledge** indicates the typical training content and expected
level of understanding for both applicants and certifying organisations, and assumes
candidates have no previous Lean Six Sigma certification.

While certification as a Green Belt will help, candidates for Black Belt certification must
demonstrate a greater depth of understanding beyond the **Green Belt Body of
Knowledge**, as well as additional tools and techniques.

The three indicated levels of understanding are defined as:

1. Awareness - know it exists, when to use it and, where applicable, interpret the output.

2. Apply - in addition to 'awareness', select and use the most appropriate technique, be
able to explain the output and take appropriate action.

3. Coach - in addition to 'apply', demonstrate the ability to coach and communicate the
underpinning concepts of the technique to Senior Management and other Belts.

DMAIC and Change Management

Demonstrate knowledge of various skills and techniques tools to effectively manage
projects, the team and process change, throughout the DMAIC process in conjunction
with the organisation's leadership.

This will include development of customer requirements, processes analysis, data
gathering and idea generation to improve the process towards the intended goal.

☐ Roles supporting a LSS team and company wide deployment. (Coach)

☐ Project management throughout DMAIC through set up, planning, control,
management and implementation through use of tools such as PERT, Gantt charts,
Activity network diagrams including critical path analysis, Milestones, tollgate reviews,
lessons learned from other projects and activities, storyboard and team meetings.
(Coach)

☐ Team support and facilitation, roles and responsibilities, conflict management, recognition, coaching and mentoring. (Coach)

☐ Gaining appropriate project commitment through Stakeholder analysis, Communications plans, influencing strategy, Drivers of Change, visioning, SWOT / PEST analysis, force-field analysis and elevator speech. (Coach)

☐ Project definition through all project charter elements; Business Case, Scope, Problem and Goal Statements from baseline. (Coach)

☐ Effective project selection through link to company strategy, operational performance, KPI's, pitfalls and Return on Six Sigma (ROSS). (Coach)

☐ Opportunity Quantification and financial drivers appropriately linked to the business accounting systems; hard vs soft benefits, budgeting, cost of poor quality, cost benefit analysis, net present value, return on investment, discounted cash flow, internal rate of return and payback period.(Apply)

☐ Analysis of project and operational risk through Process Decision Programme Chart (PDPC) or similar. (Coach)

☐ History and principles of both Six Sigma and Lean. (Coach)

☐ Methodology differences between DMAIC, DFSS and Kaizen Blitz (Coach)

☐ Effective project handover to the process owner and post implementation review. (Coach)

☐ Idea Generation, sorting and prioritisation techniques such as brainstorming, negative brainstorming, affinitisation, interrelationships diagram to key drivers, cause and effect (fishbone) and affinity tree diagrams. (Coach)

☐ Identification and segmentation of the Customers and their requirements through Kano analysis, gathering Voice of the Customer, developing CTQ's, identifying their Moments of Truth and benchmarking. (Coach)

☐ Recording the current process through appropriate techniques including SIPOC, process mapping, functional deployment / swim lane maps. (Coach)

☐ Demonstrate the ability to interrogate gathered process information to identify the root cause or causes with the team using 5-whys and logical cause matrix. (Coach)

☐ Data recognition and collection through the data measurement plan including operational definitions, collection plan, data types, $Y=f(X)$ and quantitative vs qualitative data. (Coach)

☐ Techniques to assure effective workplace and process management including standard operating procedures or documentation including operational measurements and response plan. (Coach)

☐ Alternative techniques to capture and transform customer requirements into product or process such as QFD. (Awareness)

☐ Methods to assure product or process robustness and success including FMEA and pilot tests. (Coach)

☐ Decision making tools to assure the CTQ's and business needs are achieved, including multi-voting, N/3, Prioritisation matrix, paired comparisons and X/Y Grid. (Coach)

☐ Tools and techniques to use the team to generate creative solutions to a defined problem such as 6 Thinking Hats, brainstorming, CATALYST and ideas box. (Coach) Additionally benchmarking. (Awareness)

Lean
Demonstrate understanding of the Lean tools and techniques which can be used in a DMAIC project to develop customer requirements, analyse processes, identify obstacles to flow and methods to improve it from the customers' perspective.
☐ Recording the current process through appropriate techniques including process stapling, spaghetti diagram and as-is value stream mapping. (Coach)
☐ Identify obstacles to process flow and techniques to improve it such as Value added / Non-VA analysis, Muda (7 wastes), Batches vs single piece flow (JIT), Theory of Constraints, pull vs push processing, kanban, rolled throughput yield, SMED, Poke-yoke / error proofing and standard work. (Coach)
☐ Process measurements including cycle time, touch time and takt time. (Coach)
☐ Techniques to assure effective workplace and process management including 5S, visual management, total productive maintenance (TPM) control plan. (Coach)
☐ Methods to assure product or process robustness and success including future state mapping (Coach)

Graphs
Demonstrate the ability to select appropriate graphical data displays, depending on the project objectives and type of data and know how to interpret the output.
☐ Measures and graphical representations of Central Tendancy and Variation; Mean, Median, Mode, Standard Deviation and Range using histograms, box plots and dot plots (Coach)
☐ Data relationships, scatter plots, fitted line plots and matrix plots. (Coach)
☐ Data segmentation and stratification including use of Pareto and pie charts. (Coach)
☐ Process stability over time; Individuals and moving range charts (Coach)

Statistics
Demonstrate understanding and use of the most commonly used statistical measurement, analysis and process control techniques. Understand data requirements, structure, operational principles, applications and limitations. Demonstrate how to correctly interpret and validate the statistical output.
☐ Data collection through the data measurement plan including population or process sample size calculation. (Coach)

Population and Sample Distributions; Central Limit Theorem, normal and non-normal populations, normal probability and probability plot. (Coach)

 Population and process sampling (Coach) Power and Sample Size. (Apply)

 Confidence levels, probability & p-values. (Coach)

 Statistical vs practical significance. (Coach)

 Time related data using time series plots and run charts. Identification of common cause vs Special cause variation, how to identify and act. (Coach)

 Data relationships, correlation vs causation (Coach)

 Process Capability indicators to baseline and compare process performance including Sigma, DPMO, Z-table, Cp / Cpk and Pp / Ppk, including when data are non-normal. (Coach) Also short vs long term sigma (Apply)

 Process stability over time; Xbar-R charts, rational sub-grouping and variable sample sizes. (Coach) Also Xbar-S, charts, median charts, attribute charts, P, NP, C and U. (Apply)

 Determine null and alternative hypothesis and subsequent hypothesis testing to determine statistical differences of one sample from a standard or two or more data sets; one and two sample-t tests, paired-t test, proportion test, one way ANOVA, tests for equal variances, F test and Chi squared test. (Coach)

 Ensure consistency in data collection or application of procedural requirements through Measurement System Analysis; Gauge R&R and attribute agreement analysis. (Apply)

 Examine strengths of data relationships, especially X's to Y's but also manage correlated X's; Correlation coefficient, fitted line plots, simple linear regression, confidence and prediction intervals. (Coach)

Advanced statistics
Understand and demonstrate basic awareness of more advanced process and data analysis techniques. Understand the application and limitations of these tools, data requirements and structure, interpretation and validation of the graphical and statistical output.

 Process stability over time; Time weighted charts CUSUM, Moving average and EWMA. Non time related applications (Coach)

 ANOVA main effects analysis (Apply)

 Demonstrating process changes where seasonality over time is significant. (Apply)

 Examine strengths of data relationships; Binary logistic regression, multiple regression, residuals analysis, quadratic regression and ordinal logistic regession. (Apply)

 Normalisation of non-normal data through Box-Cox, Johnson or other transformations. (Apply)

⬜ Analysis of non-normal data using non-parametric hypothesis tests. (Awareness)

⬜ Design of Experiments to test and observe the affect on 1 or more output of multiple input factors, both in isolation and combination using classical full factorial DoE, fractional factorials, blocking and replicates. The analysis of the output main effect and interaction pots, process simulation and optimisation. (Apply)

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Body of Knowledge

The Lean Six Sigma Academy has detailed a Body of Knowledge for both **Green** and **Black Belts** to indicate the typical training content and expected level of understanding for both applicants and certifying organisations.

Certification Steps

The process has four steps which follow the same pattern for candidates at both Green and Black Belt level, with the latter reflecting the greater detail, complexity and application required to reach that level.

Step 1 – Written examination

Examinations take place following training and are open book. The Green Belt exam consists of short answer, multiple choice questions focusing on concepts and simple tools of DMAIC improvement projects. The Black Belt exam is designed to test statistical and analytical skills and focuses on the use of Minitab or JMP analysis of case study data.

Step 2 –Assessment of completed project/s

Following the exam, the candidate is expected to submit details of completed projects for desktop review. This is done typically by way of storyboards and associated project documentation.

Lean and Green Belt candidates are expected to submit one completed DMAIC project while Black Belt candidates need to provide at least two completed projects. Master Black Belt candidates are expected to be able to demonstrate all the above as well as comprehensive implementation experience as well as training and mentoring expertise.

Step 3 – Interview

The candidate undergoes a 1-2 hour interview by the examiner to review the project/s submitted and to test the softer issues around leadership, change management and general understanding of Lean Six Sigma tools and concepts.

Step 4 - Feedback and recognition

Each candidate will receive a written feedback report covering their performance across all the certification criteria. Candidates who do not pass the exam/interview process will be offered further exercises to strengthen any weaker areas. Successful candidates also receive an official certificate and are added to our **Certification Register**.

Lean Six Sigma Green Belt certification

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Understanding of Lean Six Sigma:

☐ The Key Principles of Lean and Six Sigma.

☐ The different methodologies: DMAIC (Process Improvement), DMADV (Design For Six Sigma), rapid improvement events and when to use each.

☐ Roles of the Project Champion, Yellow Belt, Green Belt, Black Belt and Master Black Belt.

☐ Use of Tollgate reviews and storyboards to manage a project.

☐ Use of financial benefit analysis to gain support for change.

☐ Gaining commitment - does and don'ts.

☐ Managing change and the need for soft tools to get buy-in.

☐ The need for a systematic approach - clear understanding and application of the DMAIC methodology.

☐ Leading an Improvement Project Team

Define

☐ Project selection

☐ Project Charter including:
o Business case

o Problem and Goal statements

o Scope

o Project Milestones

o Team Roles and Responsibilities

☐ Stakeholder Analysis

☐ Communciations Plan

☐ SIPOC

☐ Gathering voice of the Customer and generating CTQ statements

☐ Project Risk Analysis

Measure

☐ As Is Process mapping.

☐ Spaghetti diagrams, process stapling, Functional deployment maps (Swim lane) and Value Stream Maps

☐ Types of data.

☐ Gathering the right data throughout the process; Understanding Output and Input process data.

☐ Sampling from populations and processes

☐ Developing a measurement plan including operational definitions and Sampling and sample size calculations.

☐ Measurement systems analysis (concepts of Gauge R&R and Attribute Agreement Analysis),

☐ Understanding Variation

☐ SPC basics including identification of common and special cause process variation and why it matters.
o Sources of variation; PEMME or similar

o How to construct control charts; XmR and X bar-R

o Awareness of other SPC charts
☐ Calculation of baseline performance and process sigma using DPMO

☐ Process capability (simple Cp and Cpk)

Analyse

☐ Process value added analysis,

☐ Cause and effect analysis; 5 Whys + fishbone diagram or similar

☐ 7 process Wastes / Muda

☐ Graphical analysis and Segmentation (Stratification) including histograms, pareto charts and scatter plots

☐ Identification and Verification of Root Causes using tools such as:
o Correlation and regression analysis - awareness

- Hypothesis testing – awareness

- Design of Experiments (DoE) – awareness

- Logical Cause Matrix
- Financial assessment of root causes – Quantified Opportunity

Improve
- Ideas generation - Brainstorming and creativity techniques

- Enabling processes to flow; push vs pull processes

- Reducing process set up or changeover time

- Organising work areas and standardising practices; 5S

- Achieving the customers requirements; Takt Time

- Removing process constraints; theory of constraints or similar

- Creating the future state process map

- Prioritisation matrix and other selection techniques (N/3 and paired comparison or equivalent)

- FMEA and error proofing (Poka Yoke)

- Project planning (7 New Tools or equivalent) and piloting

- Force field analysis,

- Cost benefit analysis

Control
- Standardisation and documentation

- Process Improvement implementation including Control plan, training plan, communications and implementation plan

- Visual Management

- Process Response plan

- Using Control Charts in the control phase to:
- Assess impact of improvement

- Understand current performance

- Monitor future performance
- Project handover and ownership

- Sustaining the gains through Process Management.

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to use specific statistical software such as Minitab, nor to understand the advanced
statistical concepts that underpin it. Hence topics such as hypothesis tests, regression
analysis and DoE are required at the awareness level only so the candidate should be
aware that these tools exist, when it might be prudent to ask for Black Belt help in running
them and sufficient understanding of the concepts and jargon to be able to define what
they need and to understand the results the Black Belt gives them.

Lean Six Sigma Black Belt certification

The **Black Belt Body of Knowledge** indicates the typical training content and expected
level of understanding for both applicants and certifying organisations, and assumes
candidates have no previous Lean Six Sigma certification.

While certification as a Green Belt will help, candidates for Black Belt certification must
demonstrate a greater depth of understanding beyond the **Green Belt Body of
Knowledge**, as well as additional tools and techniques.

The three indicated levels of understanding are defined as:

1. Awareness - know it exists, when to use it and, where applicable, interpret the output.

2. Apply - in addition to 'awareness', select and use the most appropriate technique, be
able to explain the output and take appropriate action.

3. Coach - in addition to 'apply', demonstrate the ability to coach and communicate the
underpinning concepts of the technique to Senior Management and other Belts.

DMAIC and Change Management

Demonstrate knowledge of various skills and techniques tools to effectively manage
projects, the team and process change, throughout the DMAIC process in conjunction
with the organisation's leadership.

This will include development of customer requirements, processes analysis, data
gathering and idea generation to improve the process towards the intended goal.

☐ Roles supporting a LSS team and company wide deployment. (Coach)

☐ Project management throughout DMAIC through set up, planning, control,
management and implementation through use of tools such as PERT, Gantt charts,
Activity network diagrams including critical path analysis, Milestones, tollgate reviews,
lessons learned from other projects and activities, storyboard and team meetings.
(Coach)

☐ Team support and facilitation, roles and responsibilities, conflict management, recognition, coaching and mentoring. (Coach)

☐ Gaining appropriate project commitment through Stakeholder analysis, Communications plans, influencing strategy, Drivers of Change, visioning, SWOT / PEST analysis, force-field analysis and elevator speech. (Coach)

☐ Project definition through all project charter elements; Business Case, Scope, Problem and Goal Statements from baseline. (Coach)

☐ Effective project selection through link to company strategy, operational performance, KPI's, pitfalls and Return on Six Sigma (ROSS). (Coach)

☐ Opportunity Quantification and financial drivers appropriately linked to the business accounting systems; hard vs soft benefits, budgeting, cost of poor quality, cost benefit analysis, net present value, return on investment, discounted cash flow, internal rate of return and payback period.(Apply)

☐ Analysis of project and operational risk through Process Decision Programme Chart (PDPC) or similar. (Coach)

☐ History and principles of both Six Sigma and Lean. (Coach)

☐ Methodology differences between DMAIC, DFSS and Kaizen Blitz (Coach)

☐ Effective project handover to the process owner and post implementation review. (Coach)

☐ Idea Generation, sorting and prioritisation techniques such as brainstorming, negative brainstorming, affinitisation, interrelationships diagram to key drivers, cause and effect (fishbone) and affinity tree diagrams. (Coach)

☐ Identification and segmentation of the Customers and their requirements through Kano analysis, gathering Voice of the Customer, developing CTQ's, identifying their Moments of Truth and benchmarking. (Coach)

☐ Recording the current process through appropriate techniques including SIPOC, process mapping, functional deployment / swim lane maps. (Coach)

☐ Demonstrate the ability to interrogate gathered process information to identify the root cause or causes with the team using 5-whys and logical cause matrix. (Coach)

☐ Data recognition and collection through the data measurement plan including operational definitions, collection plan, data types, $Y=f(X)$ and quantitative vs qualitative data. (Coach)

☐ Techniques to assure effective workplace and process management including standard operating procedures or documentation including operational measurements and response plan. (Coach)

☐ Alternative techniques to capture and transform customer requirements into product or process such as QFD. (Awareness)

☐ Methods to assure product or process robustness and success including FMEA and pilot tests. (Coach)

☐ Decision making tools to assure the CTQ's and business needs are achieved, including multi-voting, N/3, Prioritisation matrix, paired comparisons and X/Y Grid. (Coach)

☐ Tools and techniques to use the team to generate creative solutions to a defined problem such as 6 Thinking Hats, brainstorming, CATALYST and ideas box. (Coach) Additionally benchmarking. (Awareness)

Lean
Demonstrate understanding of the Lean tools and techniques which can be used in a DMAIC project to develop customer requirements, analyse processes, identify obstacles to flow and methods to improve it from the customers' perspective.
☐ Recording the current process through appropriate techniques including process stapling, spaghetti diagram and as-is value stream mapping. (Coach)
☐ Identify obstacles to process flow and techniques to improve it such as Value added / Non-VA analysis, Muda (7 wastes), Batches vs single piece flow (JIT), Theory of Constraints, pull vs push processing, kanban, rolled throughput yield, SMED, Poke-yoke / error proofing and standard work. (Coach)
☐ Process measurements including cycle time, touch time and takt time. (Coach)
☐ Techniques to assure effective workplace and process management including 5S, visual management, total productive maintenance (TPM) control plan. (Coach)
☐ Methods to assure product or process robustness and success including future state mapping (Coach)

Graphs
Demonstrate the ability to select appropriate graphical data displays, depending on the project objectives and type of data and know how to interpret the output.
☐ Measures and graphical representations of Central Tendancy and Variation; Mean, Median, Mode, Standard Deviation and Range using histograms, box plots and dot plots (Coach)
☐ Data relationships, scatter plots, fitted line plots and matrix plots. (Coach)
☐ Data segmentation and stratification including use of Pareto and pie charts. (Coach)
☐ Process stability over time; Individuals and moving range charts (Coach)

Statistics
Demonstrate understanding and use of the most commonly used statistical measurement, analysis and process control techniques. Understand data requirements, structure, operational principles, applications and limitations. Demonstrate how to correctly interpret and validate the statistical output.
☐ Data collection through the data measurement plan including population or process sample size calculation. (Coach)

☐ Population and Sample Distributions; Central Limit Theorem, normal and non-normal populations, normal probability and probability plot. (Coach)

☐ Population and process sampling (Coach) Power and Sample Size. (Apply)

☐ Confidence levels, probability & p-values. (Coach)

☐ Statistical vs practical significance. (Coach)

☐ Time related data using time series plots and run charts. Identification of common cause vs Special cause variation, how to identify and act. (Coach)

☐ Data relationships, correlation vs causation (Coach)

☐ Process Capability indicators to baseline and compare process performance including Sigma, DPMO, Z-table, Cp / Cpk and Pp / Ppk, including when data are non-normal. (Coach) Also short vs long term sigma (Apply)

☐ Process stability over time; Xbar-R charts, rational sub-grouping and variable sample sizes. (Coach) Also Xbar-S, charts, median charts, attribute charts, P, NP, C and U. (Apply)

☐ Determine null and alternative hypothesis and subsequent hypothesis testing to determine statistical differences of one sample from a standard or two or more data sets; one and two sample-t tests, paired-t test, proportion test, one way ANOVA, tests for equal variances, F test and Chi squared test. (Coach)

☐ Ensure consistency in data collection or application of procedural requirements through Measurement System Analysis; Gauge R&R and attribute agreement analysis. (Apply)

☐ Examine strengths of data relationships, especially X's to Y's but also manage correlated X's; Correlation coefficient, fitted line plots, simple linear regression, confidence and prediction intervals. (Coach)

Advanced statistics

Understand and demonstrate basic awareness of more advanced process and data analysis techniques. Understand the application and limitations of these tools, data requirements and structure, interpretation and validation of the graphical and statistical output.

☐ Process stability over time; Time weighted charts CUSUM, Moving average and EWMA. Non time related applications (Coach)

☐ ANOVA main effects analysis (Apply)

☐ Demonstrating process changes where seasonality over time is significant. (Apply)

☐ Examine strengths of data relationships; Binary logistic regression, multiple regression, residuals analysis, quadratic regression and ordinal logistic regession. (Apply)

☐ Normalisation of non-normal data through Box-Cox, Johnson or other transformations. (Apply)

□ Analysis of non-normal data using non-parametric hypothesis tests. (Awareness)
□ Design of Experiments to test and observe the affect on 1 or more output of multiple input factors, both in isolation and combination using classical full factorial DoE, fractional factorials, blocking and replicates. The analysis of the output main effect and interaction pots, process simulation and optimisation. (Apply)