KEMENTERIAN TENAGA, SAINS, TEKNOLOGI, ALAM SEKITAR DAN PERUBAHAN IKLIM

Malaysian Science and Technology Information Centre (MASTIC)
Ministry of Energy, Science, Technology, Environment and Climate Change

Session 4:
Data - Quality Control & Analysis

February 2019

NATIONAL SURVEY OF RESEARCH AND DEVELOPMENT (R&D) IN MALAYSIA 2017

PE Research
Planning & Economic Consultants

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Outline – Data Quality Control & Analysis

01 QC AND QA METHOD ON DATA COLLECTED

1. Overall QC Flow and Process
2. QC Error Checking – Threshold, Criteria and etc.

02 DATA ANALYSIS

1. Data Analysis Steps
2. Step 1 - Develop a Data Analysis Plan
3. Step 2 - Develop Appropriate Analytical Technique
4. Step 3 - Perform Analysis
5. Step 4 - Communicating your Statistical Findings

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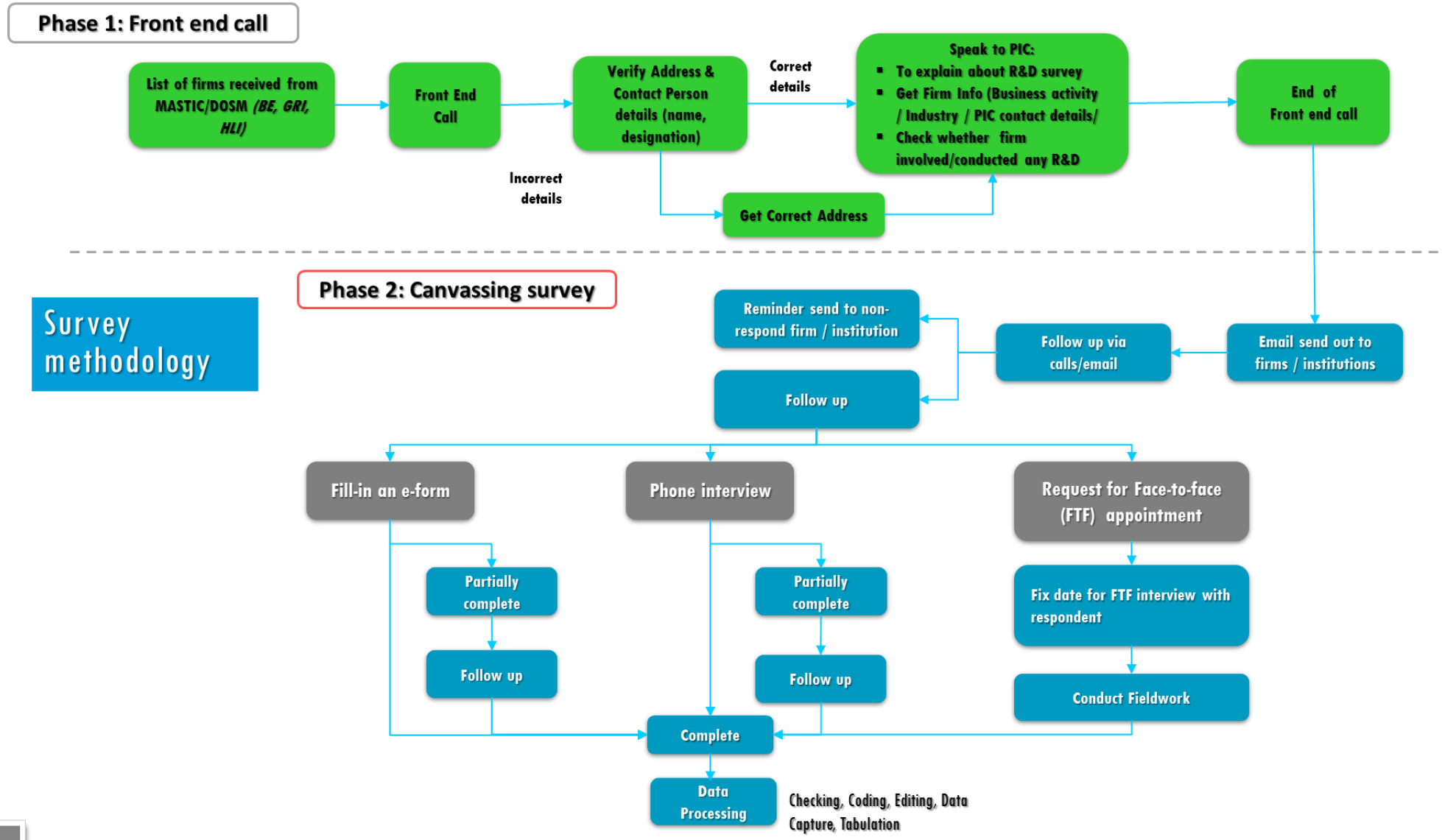
01

QC AND QA METHOD ON DATA COLLECTED

1. **Overall QC Flow and Process**
2. QC Error Checking – Threshold, Criteria and etc.

Overall Survey Flow for BE



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01

QC AND QA METHOD ON DATA COLLECTED

1. Overall QC Flow and Process
2. **QC Error Checking – Threshold, Criteria and etc.**

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QC STEPS

1 Check Section 1: Company Profile - whether organisation engage in R&D or not

- NO – Check whether Section 1 is complete
- YES – conducted and funded
- YES (only funded)

2 Check questions with total of 100%: Field of Research, Socio-economic Objective, Types of R&D Activities and Location of R&D

3 Check Section 3: R&D Personnel - the estimated Total Full-time Equivalent (FTE) =< Total of Headcount provided

If Total FTE is lesser than total of headcount, double check whether total FTE represent the total headcount or average FTE / person

4 Check on the Total Salary & Emoluments (TYSE) for all Internal and External R&D personnel

- TYSE for Internal R&D must equal with Total Labour cost under Current expenditure in Section 4: R&D Expenditure & Source of Funds
- When there's data provided under 'Other Recurrent Cost' (Section 4) – there must be External R&D personnel information (Headcount, Estimated FTE)

5 Check on the total R&D Expenditure = Total Source of Funds

6 Check Section 5: R&D Outsourced

7 After QC completed, data is imported to clean database for analysis

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Check whether organisation engage in R&D

SECTION 1: ORGANISATION PROFILE

1. Main activity of the organisation
Please choose only ONE industry (from dropdown list) that best describes your business

Industry:
Human Health and Social Work Activities (Q)

Description:
Provide advocacy, education and support to public and patient in cancer related issues

2. Ownership structure
Please report the ownership of the organisation based on the paid-up capital for 2016.

	Percentage (%)
a) Held directly by Malaysian If 100% Malaysian, please respond to the following:	
Bumiputera	
Non-Bumiputera	
b) Held directly by Non-Malaysian Foreign (e.g. US, Japan, Britain, France, Germany, etc). Please specify:	
Total	**0.0**

3. Please specify the total number of full-time employees in 2016

6. Did your organisation engage in any R&D activity in 2016?
Include:
a) Subcontractors working on R&D projects carried out by your organization
b) R&D projects funded by your organisation, but totally carried out by other organisations, or a subsidiary of this organisation

- ☒ No, (end of survey, thank you)
- ☐ Yes, conducted and funded R&D activities (please complete the entire survey, thank you)
- ☐ Yes, **only funded** R&D activity (please complete the survey but **skip Section 3**, thank you)

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Check all Questions with a total of 100%.
E.g: FOR, SEO, R&D Activities and Location of R&D

Please choose your R&D activities based on the Socio-economic Objective (SEO)
(The sum of all expenditure breakdown must be 100%)

Expenditure (%)

	Defense and Security
	Sustainable Economic Development
	Society
	Environment
	Advancement of Knowledge
100	Advanced Experimental and Applied Science
100.0	TOTAL (Total must equal to 100%)

Which of the following types of R&D activities were carried out?
Please allocate to each type the relevant percentage of R&D expenditure reported in 2016.
(The sum of the expenditure breakdown must be 100%)

Expenditure (%)

	Basic Research Pursue a planned search for knowledge with either a broad underpinning reference, or no reference to a likely application
100.0	**Applied Research** (a) New work undertaken to acquire knowledge for a specific practical aim (b) Work to determine possible uses of basic research (c) Work to determine new ways of achieving a predetermined objective
	Experimental Research Systematic work undertaken using existing knowledge for the purpose of creating new or improved materials, products, processes, and/or services.
100.0	**TOTAL** (Total must equal to 100%)

9. Location of R&D Projects in Percentage of Activities (%)
Please indicate the location (by state) of the reported R&D project. If the project was conducted in more than one location, please indicate the breakdown (by percentage of research activities (not in terms of expenditure)) carried out in the various locations.

Johor	%	Perak	%	Sarawak	%
Kedah	%	Perlis	%	WP Kuala Lumpur	%
Kelantan	%	Pulau Pinang	%	WP Labuan	%
Melaka	%	Selangor	100.0 %	WP Putrajaya	%
Negeri Sembilan	%	Terengganu	%	Other countries (Please specify):	%
Pahang	%	Sabah	%		
				Total	100.0 %

Make sure the total is 100%

Check the estimated Total FTE : must be SAME or lesser than total of headcount provided

(i) Internal R&D Personnel - persons who are involved in R&D and under the organisation's payroll

Researchers are professionals engaged in the conceptualisation or creation of new knowledge, products, processes, methods and systems, and in the management of the projects concerned. Postgraduate students at the PhD level engaged in R&D should be considered as researchers.

Researchers / Highest Qualifications	Headcount				Total Headcount	Estimated Total FTE	Total Yearly Salary & Emoluments (RM)
	Malaysian		Non-Malaysian				
	Male	Female	Male	Female			
Doctoral	17	3	0	0	20	5.00	
Master	23	12	0	0	35		928679.00
Bachelor	35	20	0	0	55		
Others					0		

If Total FTE is lesser than total of headcount, double check whether total FTE represent the total headcount or average FTE

There's a possibility of Error : Estimated FTE does not represent the total headcount

Re-check with PIC when the estimated TFTE is blank or '0' while there's figure for total HC

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Check on the Total salary & Emoluments for all Internal and External R&D personnel

(i) Internal R&D Personnel - persons who are involved in R&D and under the organisation's payroll

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Doctoral	17	3	0	0	20	5.00	928679.00
Master	23	12	0	0	35		
Bachelor	35	20	0	0	55		
Others					0		

1

	Headcount		Total Headcount	Estimated Total FTE	Total Yearly Salary & Emoluments (RM)
	Male	Female			
Technicians & equivalent staff	54	10	64		212406.00
Other supporting staff	16	41	57		278599

2

Total Yearly Salary & Emoluments (TYSE) for Internal R&D personnel must tally with Labour cost under Current expenditure

1 + 2 = 3

7. Please provide a breakdown of the total R&D expenditure for 2016:

Current Expenditure	Amount spent (RM)
i. **Labour Cost** Sum of the basic annual salary and other emoluments (such as EPF contributions, medical benefits, performance bonuses, special allowances, housing and car loans of each personnel involved directly in R&D)	35481395.49

3

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Check on the Total salary & Emoluments for all Internal and External R&D personnel

(ii) External R&D Personnel (or contributors) - independent (self-employed) or dependent (employee) workers fully integrated into a statistical unit's R&D projects without formally being persons employed by the unit.

UNPAID Graduate Research Students / Highest Qualifications	Headcount		Total Headcount	Estimated Total FTE
	Male	Female		
Doctoral	0	0	0	
Master (by Research Mode)	0	0	0	
Others (please specify):			0	

A

Current Expenditure	Amount spent (RM)
i. **Labour Cost** — Sum of the basic annual salary and other emoluments (such as EPF contributions, medical benefits, performance bonuses, special allowances, housing and car loans of each personnel involved directly in R&D)	35481395.49
ii. **Operating Costs** — Such as consumables, repairs, maintenance, purchasing of materials, prototypes, subscription to reference databases and commissioned work	54187664.36
iii. **Other Recurrent Cost** — Payment for the salary and wages for graduate research assistants (GRA) who are either studying MSc (by research mode) or PhD programs (can be obtained from VOTE11000) + total cost of other external R&D personnel.	10000.00

B

When there's data provided under 'Other Recurrent Cost', B

there must be External R&D personnel information (Headcount, Estimated FTE) in A

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Check on the total R&D expenditure - must equal with total source of funds

Current Expenditure	Amount spent (RM)
i. **Labour Cost** — Sum of the basic annual salary and other emoluments (such as EPF contributions, medical benefits, performance bonuses, special allowances, housing and car loans of each personnel involved directly in R&D)	35481395.49
ii. **Operating Costs** — Such as consumables, repairs, maintenance, purchasing of materials, prototypes, subscription to reference databases and commissioned work	64187664.36
iii. **Other Recurrent Cost** — Payment for the salary and wages for graduate research assistants (GRA) who are either studying MSc (by research mode) or PhD programs (can be obtained from VOTE11000) + total cost of other external R&D personnel.	0.00

Capital Expenditure	Amount spent (RM)
i. **Land, building & other structures** — Note: If the land and buildings purchased are also used for production, please include only the portion used for R&D.	0.00
ii. **Vehicles, plants, software, machinery & equipment** — If the assets purchased are also used for production, please include only the portion used for R&D.	20380697.14
Sub-total	20380697.14
A **TOTAL**	**120049756.99**

Source of Funds	RM
A. **Organisation-owned fund(s)** — Internal funds from your organisation. For Government Agencies & Research organisations: As the government is the original source of funds, and have given at least half of the funds to be devoted to R&D, the government should be credited as a source of funds. This includes capital and operating expenditures, including yearly labour costs for research personnel involved in R&D.	0.00
B. **Business Enterprises**	
i. Public (e.g. GLC)	101222675.05
ii. Private (e.g. Astro, Maxis, Air Asia)	0
Sub-total	101222675.05
C. **Government**	
i. Federal Government R&D funds	0.00
ii. State or local government funds	0.00
iii. Other government funds	2701820.00
Sub-total	2701820.00
D. **Other funds - including government incentives (Please specify)**	
i.	
ii.	
iii.	
Sub-total	0.00
E. **Foreign funds (Please specify)**	
i.	
Sub-total	0.00
B **TOTAL**	**103924495.05**

not equal ✗

Check on the section 5: R&D Outsourced

SECTION 5: R&D OUTSOURCED

10. In 2016, did your organisation fund any R&D that was carried out at other organisations or outsourced R&D projects to other organisations/individuals?

Include: funding to a subsidiary of your organisation
Don't include: subcontractors working on R&D projects carried out by your organisation

- ☒ Yes, Please proceed to Q11
- ☐ No, Please proceed to Q15

If "Yes", it was compulsory to answer Question 11-13

11. Please tick (√) the reason(s) for outsourcing the R&D project(s)

- ☐ Lack of skilled R&D personnel with requisite knowledge
- ☐ Lack of facilities and equipment to conduct R&D activities
- ☐ Others (Please specify):

02

DATA ANALYSIS

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Four Main Steps in Data Analysis

02

DATA ANALYSIS

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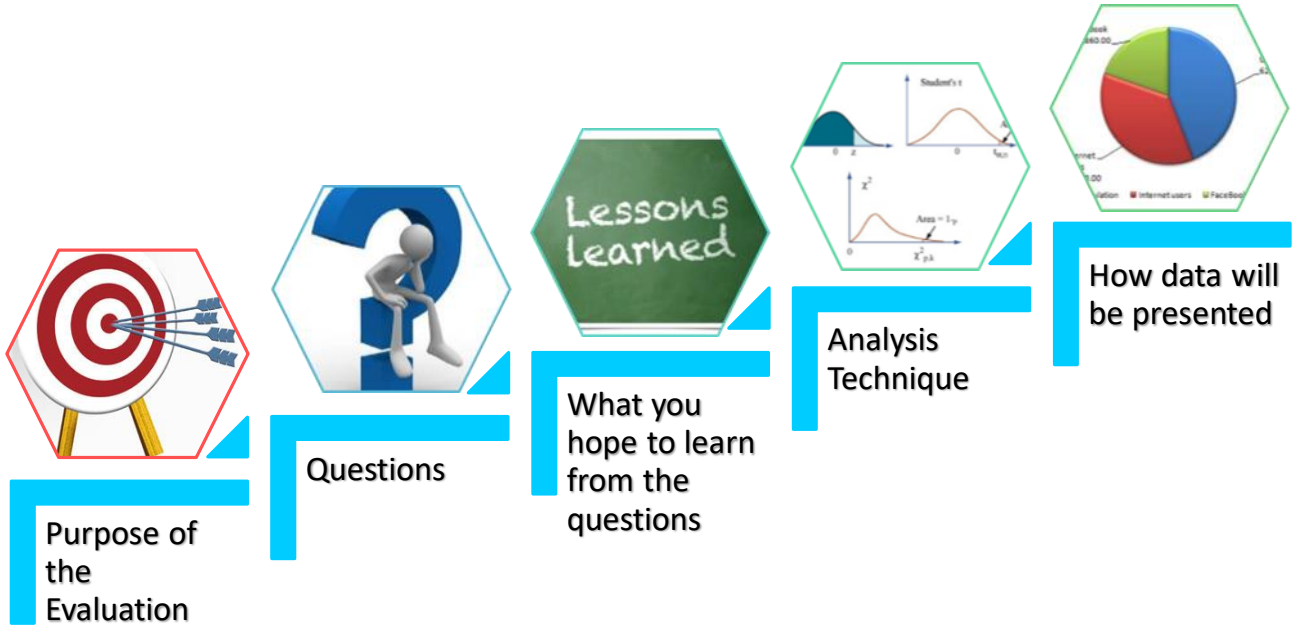
Developing a Data Analysis Plan

What is a Data Analysis Plan?

- The process of data analysis, is the process of turning data into meaningful information.
- Although there are no hard and fast rules for how to analyse statistical data, ensuring that you have a methodical and systematic approach is vital to ensuring your analysis is accurate.
- Poor quality analysis can lead you to draw incorrect and inappropriate conclusions.



STEP 1 Develop a Data Analysis Plan

Step 1
Develop a Data Analysis Plan

- Draw up an analysis plan early to ensure analysis is both efficient and meaningful
- Identify the issues or questions you require information about, specify objectives, and formulate expectations
- To ensure the analysis conducted is appropriate for addressing the underlying objective, it is vital that you understand the issue you are investigating
- It is also necessary to understand the interrelationships that exist between relevant social, economic and/ or environmental factors relating to the issue
- You can then formulate a set of questions which you're seeking answers and specify your objectives for analysing the data.

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STEP 2 Develop Appropriate Analytical Technique

Step 2
Determine Appropriate Analytical Technique

- Determining which analytical techniques are appropriate for investigating the data is necessary before any analysis takes place.
- The different analytical tools and techniques available range from simple (e.g. measures of spread) to quite complex (e.g. modelling).
- Keep in mind that some analytical techniques are not always appropriate for all sets of data.
- It is important to ensure that appropriate techniques are used in order to avoid misinterpretation or misleading results.

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STEP 2 Develop Appropriate Analytical Technique

Step 2
Determine Appropriate Analytical Technique

- The appropriate methods of data analysis are determined by your data types and variables of interest, the actual distribution of the variables, and the number of cases.
- Different analyses of the same dataset may reflect or represent different aspects of the underlying data structure.
- The different analytical techniques can be broadly broken down into summary statistical measures and graphical analysis, however these are often used in combination.

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Before you embark on data analysis, you need to know how your data looks like

Step 2
Determine Appropriate Analytical Technique

Variables

A variable is any characteristics, number, or quantity that can be measured or counted. A variable may also be called a data item.

Age, gender, expenditure, source of funds, worker nationality, main business activity and state are examples of variables. It is called a variable because the value may vary between data units in a population, and may change in value over time.

Variable Type

Numerical?

Numeric variables have values that describe a measurable quantity as a number, like 'how many' or 'how much'. Therefore numeric variables are quantitative variables. The data collected for a numeric variable are quantitative data.

Categorical?

Categorical variables have values that describe a 'quality' or 'characteristic' of a data unit, like 'what type' or 'which category'. Categorical variables fall into mutually exclusive (in one category or in another) and exhaustive (include all possible options) categories. Therefore, categorical variables are qualitative variables and tend to be represented by a non-numeric value.

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Cont..

Step 2
Determine Appropriate Analytical Technique

Codes

Coding means the transformation of data into a form understandable by computer software. The classification of information is an important step in preparation of data for computer processing with statistical software.

A Code is a List of Categories:

Divides up content in a systematic, meaningful way	• Gender=Male vs. Female • Fruit=Apples, Oranges, Pears, Bananas, Other
May assign numbers to the categories	• Such numbers do not have NUMERIC meaning • They simply refer to the different categories
Coding means assigning content to categories	• A data field with coded categories is a "variable" • Provides a systematic basis for analysis

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Cont..

Step 2
Determine Appropriate Analytical Technique

Keep a Codebook

When performing coding, it is important to keep track of what we code, and how we code it. This is usually kept in a codebook, which documents what each variable means.

MALE=1
FEMALE=2

It's a guide for locating variables and interpreting codes in the data file during analysis.

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Decide on the types of Analysis Strategy

Step 2
Determine Appropriate Analytical Technique

Exploratory

- This type of data analysis often occurs when a program is new, and it is unclear what to expect from the data.

Descriptive

- The most common type of data analysis, this approach will summarise your findings and describe the sample.
- With descriptive statistics you are simply describing what is or what the data shows.

Inferential

- With inferential statistics, you are trying to reach conclusions that extend beyond the immediate data alone.
- These powerful techniques may be able demonstrate if a change has occurred as a result of your program

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What do we look for in Exploratory Analysis?

Step 2
Determine Appropriate Analytical Technique

Control Totals

How many cases or records are there in the database?

Distribution of the data

What is the shape of the data?

Missing Value

How much missing data is there and how should it be handled?

Consisten-cies between variables

Do the data need cleaning for consistency?

Outliers

Should they be included or excluded in the analysis?

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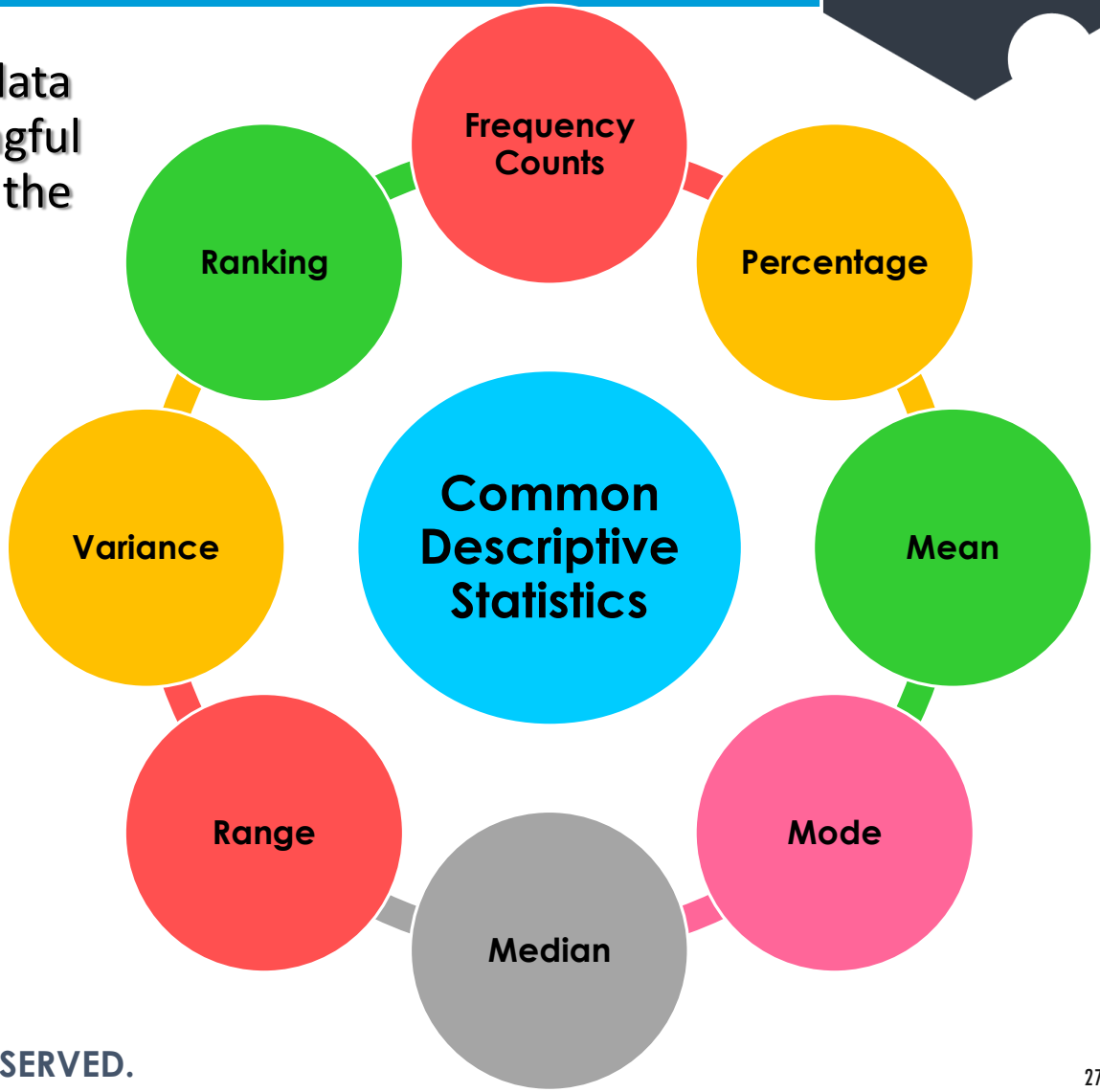
Descriptive Data Analysis

Step 2
Determine Appropriate Analytical Technique

- Descriptive statistics is the term given to the analysis of data that helps describe, show or summarize data in a meaningful way such that, for example, patterns might emerge from the data.

1. Together with simple graphics analysis, they form the basis of virtually every quantitative analysis of data.
2. Descriptive Statistics are used to present quantitative descriptions in a manageable form. Each descriptive statistic reduces lots of data into a simpler summary.
3. Descriptive statistics provide a powerful summary that may enable comparisons across people or other units.



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Inferential Statistics Analysis

Step 2
Determine Appropriate Analytical Technique

- Techniques that allow us to study samples and then make generalizations about the population.
- Inferential statistics are a very crucial part of scientific research in that these techniques are used to test hypotheses

Uses for Inferential Statistics

Statistics for determining differences between experimental and control groups in experimental research

Statistics used in descriptive research when comparisons are made between different groups

These statistics enable the researcher to evaluate the effects of an independent variable on a dependent variable

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STEP 3 Perform Analysis

Step 3
Perform Analysis

- Things to consider before performing analysis
- Decide on what you want to report

How many people answered a, b, c, d?

The average number or score?

How people compared?

How many time periods compared?

Need to derive new variables?

Use descriptive statistics and/or inferential statistics?

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Reporting your Analysis

Step 3
Perform Analysis

Keep it simple

Aim for a systematic effort

Keep your audience in mind

Pay attention to the usability of your evaluation report

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02

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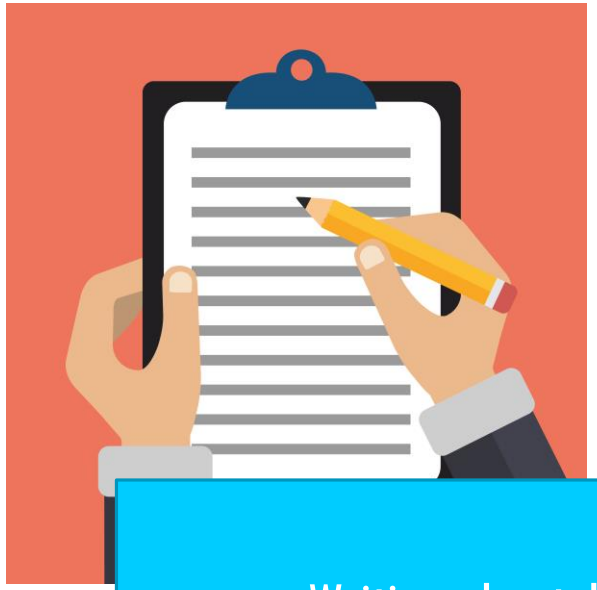
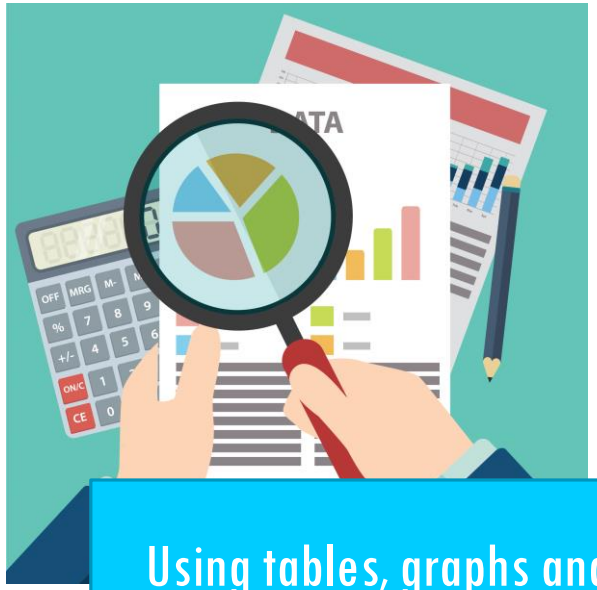
STEP 4 Communicating your Statistical Findings

Step 4
Communicating your Statistical Findings

- Being able to turn data into information or communicate statistical information accurately is vital for effective decision-making.



Writing about data



Using tables, graphs and maps to communicate statistical findings

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Writing about data

Step 4
Communicating your Statistical Findings

Writing about statistics provides an opportunity to present your analysis in a way that tells a story about the data.

In effect, statistical writing can bring data to life, making it real, relevant and meaningful to the audience.

When communicating statistical information it is important to ensure that the information presented is clear, concise and accurate.

It is also important to provide contextual information and to draw out the main relationships, causations and trends in the data.

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Using tables, graphs and maps to communicate statistical findings

Step 4
Communicating your Statistical Findings

Story by evidence

- Whether writing a report or making a presentation, the story should be told by your evidence. A simple table, graph or map can explain a great deal, and so this type of direct evidence should be used where appropriate.

Effective tables, graphs or maps

- While representing statistical information in tables, graphs or maps can be highly effective, it is important to ensure that the information is not presented in a manner that can mislead the reader.

Link to message

- The key to presenting effective tables, graphs or maps is to ensure they are easy to understand and clearly linked to the message.

Provide all the necessary info

- Ensure that all the necessary information required to understand what the data is showing is provided, as the table, graph or map should be able to stand alone.

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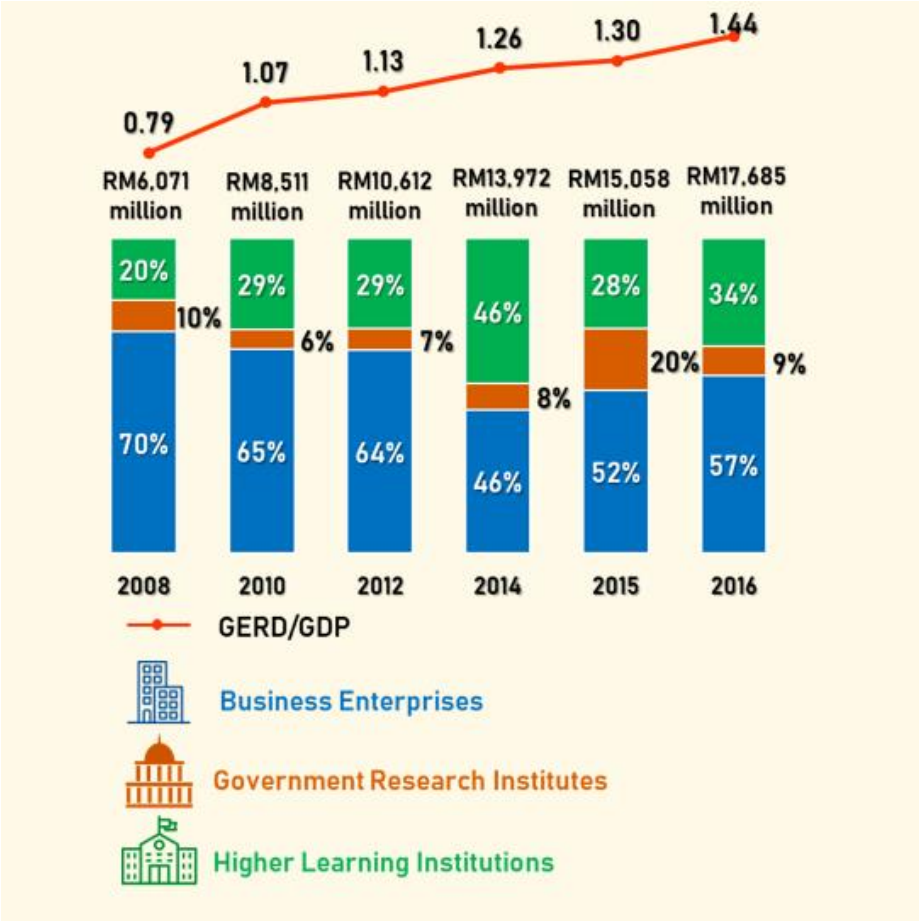
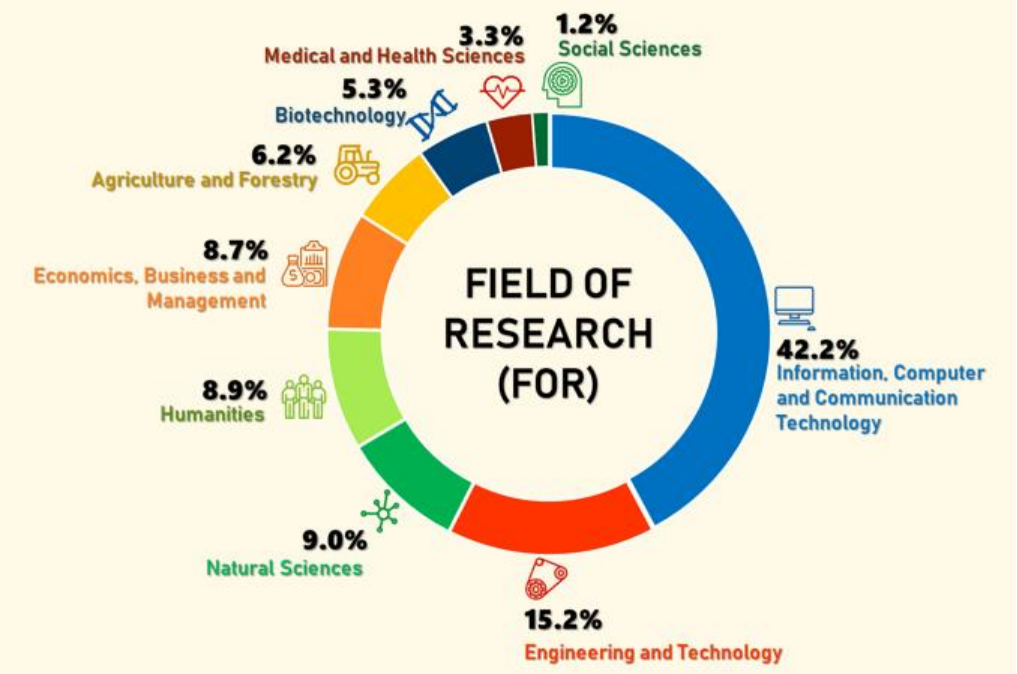
Examples

Step 4
Communicating your Statistical Findings





NATIONAL SURVEY OF RESEARCH AND DEVELOPMENT (R&D) IN MALAYSIA 2017

The End

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