

Overview of Bayesian Approaches in Survival Analysis using SAS

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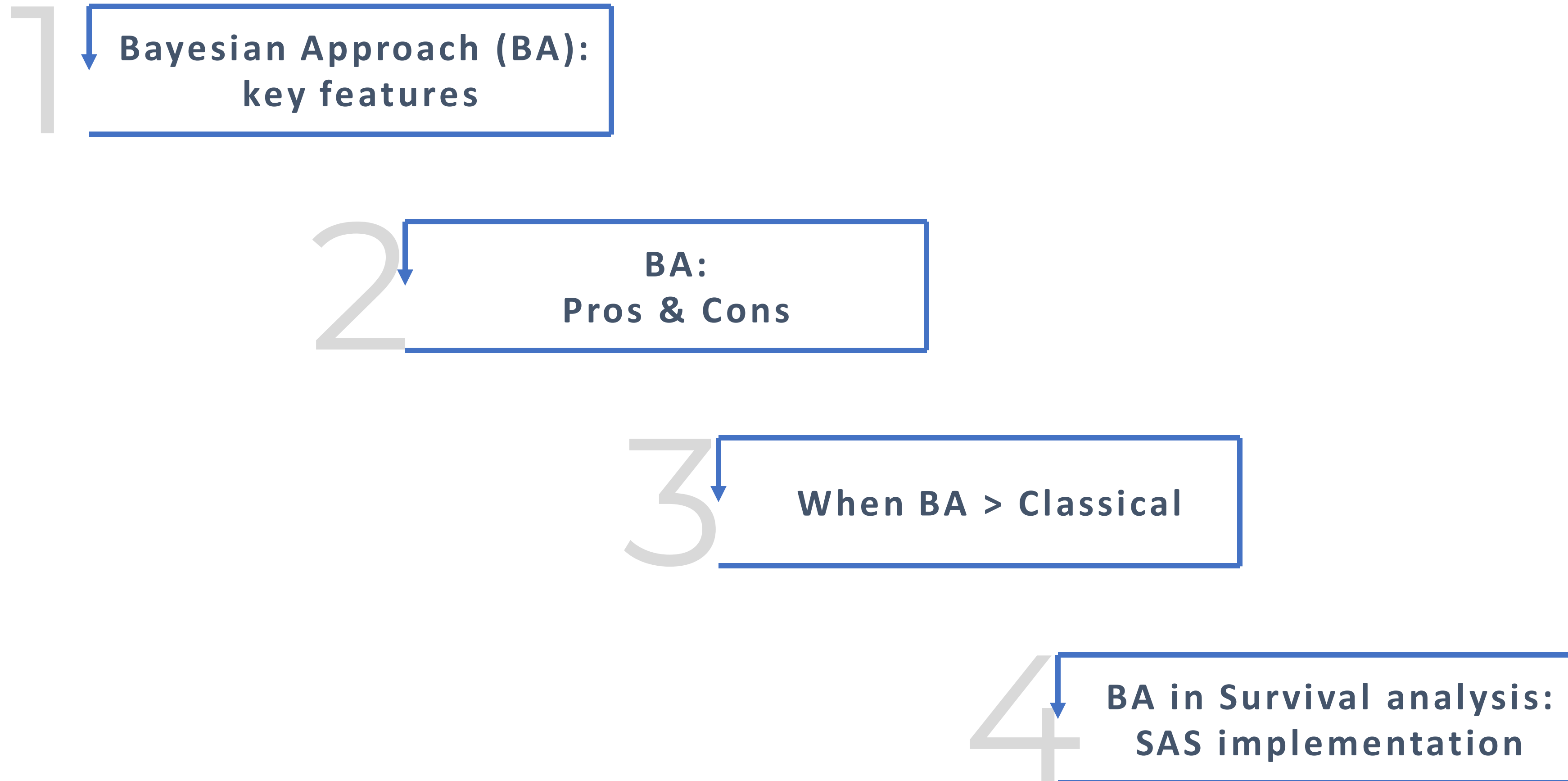


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The Clinical Data
Science Conference

CONTENT OVERVIEW



Key Features

- Parameters are treated as random variables

Goal: to estimate θ from data $y = \{y_1, \dots, y_n\}$ by using a statistical model described by a density $p(y/\theta)$.

- Probability is defined as “degrees of belief”

A probability distribution for θ is formulated as $\pi(\theta)$, which is known as the prior distribution.

Given the observed data y , you choose a statistical model $p(y/\theta)$ to describe the distribution of y given θ .

You update your beliefs about θ by combining information from the prior distribution and the data through the calculation of the posterior distribution, $p(y/\theta)$.

A graphic featuring the text "Bayesian Approach" in a large, bold, dark blue font. The text is centered within a light gray outline of a triangle. To the right of the triangle is a solid blue upward-pointing triangle. Below the triangle is a solid blue square.

Bayesian Approach

Advantages

- Ease of interpretation
- Avoids misinterpretation of p-value
- Flexibility
- Obtained posterior distribution can be considered as a prior for further stages of analysis

Disadvantages

- Impact of prior distribution selection – supported by historical knowledge, expert opinion etc.
- High computational cost – requires additional infrastructure and proper program implementation



Cases when using Bayesian approach to **survival analysis**

can be more beneficial than using likelihood-based method:

- Adaptive design trial
- Midcourse changes to a trial
- Clinical trial monitoring - posterior predictive probability can be updated at any time as the data accrue during the trial.
- Fit realistic models to complex data sets with:
 - measurement error,
 - censored or missing observations,
 - multilevel or serial correlation structures,
 - multiple endpoints
 - sensitivity analysis



**Bayesian
Approach**

BAYES STATEMENT



Cox proportional hazard model with pre-defined priors on the regression coefficients. Bayesian analysis for the piecewise exponential model.

Parameter	Prior
Regression coefficients	Normal, uniform, Zellner g-prior
g (Zellner)	Constant, gamma
Baseline hazards (original scale)	Improper, uniform, gamma, independent gamma, AR(1)
Baseline hazards (log scale)	Uniform, normal
Log-hazards and regression coefficients	Joint multivariate normal

BAYES STATEMENT



Parametric lifetime models. Normal and uniform priors are provided for the regression coefficients, and the gamma and improper priors are provided for the scale and shape parameters.

Parameter	Prior
Regression coefficients	Normal, uniform
Exponential scale	Gamma, improper
Location-scale model scale parameter	Gamma
Weibull scale	Gamma
Three-parameter gamma shape	Normal
Weibull shape	Gamma

BAYES STATEMENT

Parameter	Prior
Regression coefficients	Jeffreys', normal, uniform
Dispersion	Gamma, inverse-gamma, improper
Scale, precision	Gamma, improper



Produces Bayesian analyses for linear regression and logistic regression, it also provides Bayesian analysis for Poisson regression, negative binomial regression

BAYES STATEMENT

Specification of Prior Information	
MIXPRIORPARMS=	Specifies the prior parameters for the Dirichlet distribution of the mixing probabilities
BETAPRIORPARMS=	Specifies the parameters of the normal prior distribution for individual parameters in the vector
MUPRIORPARMS=	Specifies the parameters of the prior distribution for the means in homogeneous mixtures without effects
PHIPRIORPARMS=	Specifies the parameters of the inverse gamma prior distribution for the scale parameters in homogeneous mixtures
PRIOROPTIONS=	Specifies additional options used in the determination of the prior distribution



Provides Bayesian analysis for finite mixtures of normal, T, binomial, binary, Poisson, and exponential distributions.



Thank you!