ANALYSIS OF THE POLLUTION POTENTIAL OF MAHAKAM RIVER WATER IN TROPICAL RAIN FOREST ENVIRONMENT EAST KALIMANTAN USING WEIBULL REGRESSION MODEL

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THE PRESENTATION MATERIALS

I
- Introduction (the problem background)

II
- Method of research and Stages of data analysis

III
- Research result and Discussion

Introduction (problem background)

- Many activities around Mahakam watershed, such as restaurants, fishery, industries, mining, and resident's house were **in the potential of generating waste in the river flow.**
- The increasing waste in the river water will increase the potential of water pollution that can threaten public health, so **it is necessary to prevent water pollution**.
- One of the proposed prevention of the water pollution statistically is to provide information to the East Kalimantan people about the factors affecting the Mahakam River water pollution using **Weibull regression model**.

The goal of Study :

To obtain the Weibull regression model to the DO data of Mahakam River water

To find out the factors that influence Mahakam River water pollution

To interpretate the model based on obtained Weibull regression model

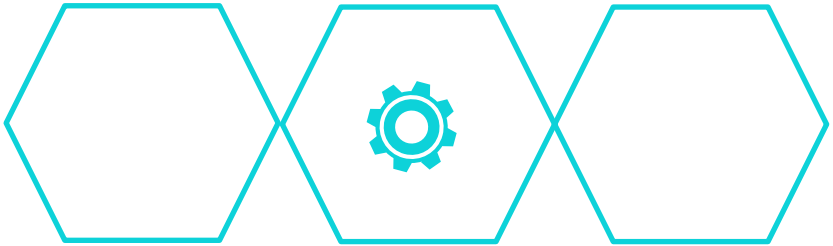
Research Method

- Research time : Sept - Nov 2022
- Place: Applied Statistics Laboratory

❑ Analysis Technique :
Weibull Regression Modeling

Population and Sample:

- ✓ Population is all point in watershed Mahakam river which data is taken
- ✓ The Sample Data is point in watershed Mahakam river which data is taken in 2021



Vareables :

Y = DO (mg/l) >>> response

Covariates :

X_1 = TDS (mg/l)
X_2 = TTS (mg/l)
X_3 = Water discharge (m^3/sec)
X_4 = Temperature (℃)
X_5 = Nitrate concentration (mg/l)
X_6 = Ammonia concentration (mg/l)
X_7 = Phosphate concentration (mg/l)
X_8 = Total of Ferro concentration (mg/l)

Sampling Technique and Data

- ✓ Sampling Technique : *purposive sampling*
- ✓ Research data is is secondary taken from Live Environmental Department of East Kalimantan

Analysis Technique : Weibull Regression Modeling (WR)

Weibull regression is regression model obtained from Weibull distribution with scale parameter (λ) which is stated in term of parameter regression

$$\ln\lambda = -\boldsymbol{\beta}^T\mathbf{x} = -(\beta_0 + \beta_1 X_1 + \cdots + \beta_p X_p) \quad \text{or} \quad \lambda = \exp\left[-\boldsymbol{\beta}^T\mathbf{x}\right], \tag{1}$$

with, $\boldsymbol{\beta} = \begin{bmatrix}\beta_0 & \beta_1 & \cdots & \beta_p\end{bmatrix}^T$; $\mathbf{x} = \begin{bmatrix}1 & X_1 & \cdots & X_p\end{bmatrix}^T$

The general model of Survival Weibull regression is

$$S(y\,|\,\mathbf{x}) = \exp\left(-\lambda(\mathbf{x})y^{\gamma}\right) = \exp\left(-y^{\gamma}\exp\left(-\boldsymbol{\beta}^T\mathbf{x}\right)\right) \tag{2}$$

Weibulll *hazard regression model is*

$$h\left(y\,|\,\mathbf{x}\right) = \gamma\lambda(\mathbf{x})y^{\gamma-1} = \gamma y^{\gamma-1}\exp\left(-\boldsymbol{\beta}^T\mathbf{x}\right) \tag{3}$$

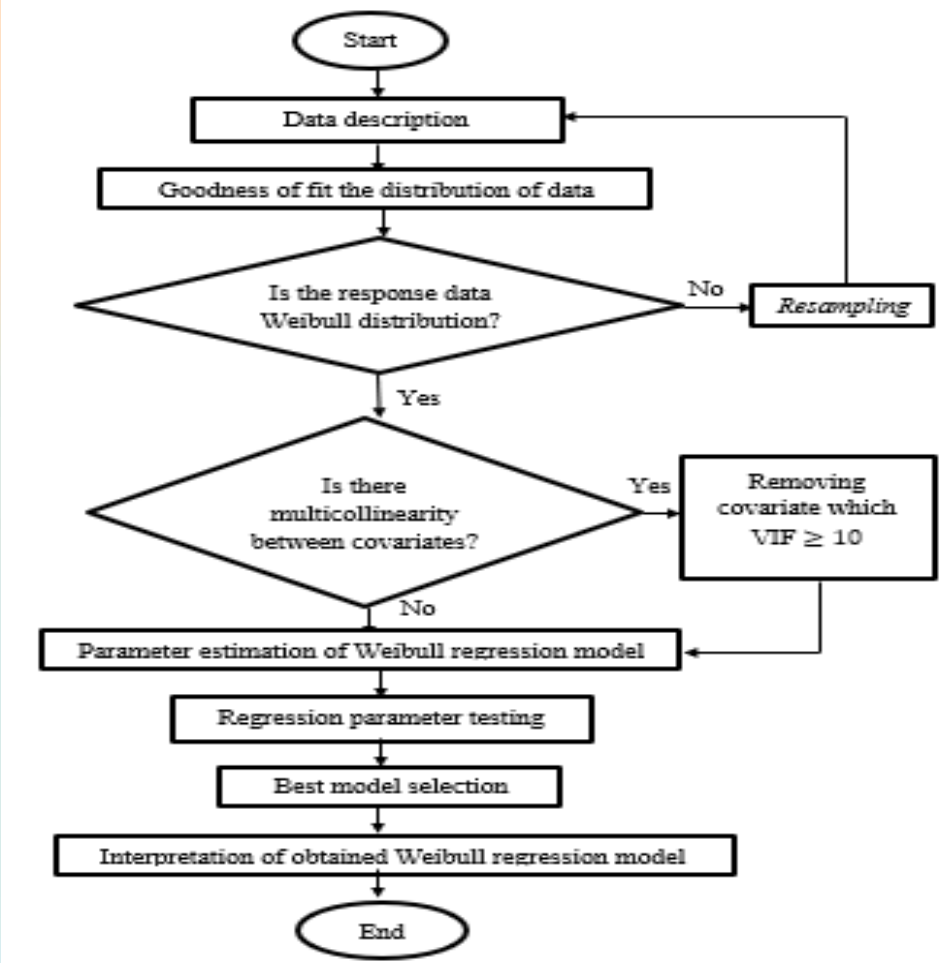
Weibull Regression model for mean is

$$\mu_y(\mathbf{x}) = \left(\lambda(\mathbf{x})\right)^{-\frac{1}{\gamma}}\Gamma\left(\frac{1}{\gamma}+1\right) = \Gamma\left(\frac{1}{\gamma}+1\right)\exp\left[\frac{1}{\gamma}\boldsymbol{\beta}^T\mathbf{x}\right] \tag{3}$$

Berdasarkan persamaan (2.14), FKP (2.2) dapat dinyatakan dalam parameter regresi, yaitu:

$$f\left(y\,|\,\mathbf{x}\right) = \gamma y^{\gamma-1}\exp\left(-\boldsymbol{\beta}^T\mathbf{x}\right)exp\left(-y^{\gamma}\exp\left(-\boldsymbol{\beta}^T\mathbf{x}\right)\right) \tag{4}$$

Stages of Data Analys



Result and Discussion

The first step of data analyzing :

- ✓ Goodness of fit of data distribution **>>> Weibull**
- ✓ Multicollinearity Detection **>>> there is no the multicollinear between covariates**
- ✓ Parameter estimation Method is **MLE**

Best Model of Weibull Regession (WR) to DO Data

❑ **ML estimator of Parameter of WR Model**

Parameter	ML Estimator
γ	6.9169
β_0	20.3943
β_2	-0.0050
β_4	-0.3015
β_8	-1.4558

❑ Weibull Survival Regression Model :

$$S(y \mid \mathbf{x}) = \exp\left(-y^{6.9169} \exp\left(-20.3943 + 0.0050x_2 + 0.3015x_4 + 1.4558x_8\right)\right)$$

❑ Weibull Hazard Regression Model :

$$h(y \mid \mathbf{x}) = 6.9169y^{5.9169} \times \exp\left(-20.3943 + 0.0050x_2 + 0.3015x_4 + 1.4558x_8\right)$$

❑ WR Model for mean :

$$\mu_y(\mathbf{x}) = 0.9349 \exp\left(2.9485 - 0.0007x_2 - 0.0436x_4 - 0.2105x_8\right)$$

Hypothesis Testing of Regression Parameters

- Hypothesis Testing of Regression Parameters Simultaneously

Hypothesis form of Parameter testing simultaneously :

$H_0 : \beta_2 = \beta_4 = \beta_8 = 0$

H_1 : at least one $\beta_k \neq 0; k = 2, 4, 8$

Result of Hyphotesis Testing of Regression Parameters Simultaneously

Test Statistic (G)	$\chi^2_{0,10(3)}$	*p-value*	Disesion
14.9748	7.8147	0.0018	H_0 is rejected

Conclusion : WR model is fit

- The potential prediction of Mahakam River Water is polluted :

S(y|x)	F(y|x)	h(y|x)	$\mu_y(\mathbf{x})$
0.4726	0.5274	1.3256	4.5710

- Hypothesis Testing of Regression Parameters Partially

Hypothesis form for certain k ; $k = 0, 2, 4, 8$:

$H_0 : \beta_k = 0$

$H_1 : \beta_k \neq 0$

Result of Parameter Testing Partially (significant level $\alpha = 10\%$)

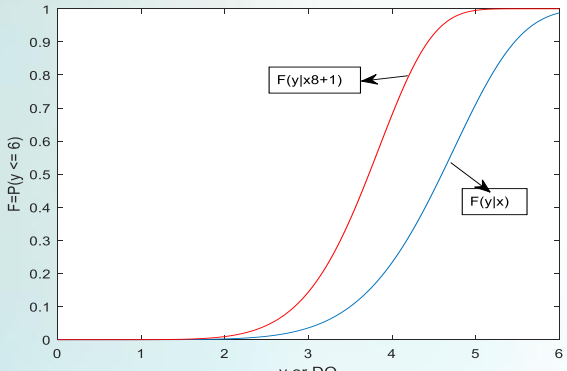
Covariate	Para-meter	Estima-tor	SE	$\lvert W_0 \rvert$	*p-value*	Desision
Intercept	β_0	20.3943	4.9143	4.1500	0.0000*	H_0 is rejected
TDS (X_2)	β_2	-0.0050	0.0028	1.7921	0.0731	H_0 is rejected
Temperature (X_4)	β_4	-0.3015	0.1497	2.0139	0.0440*	H_0 is rejected
Ferro (X_8)	β_8	-1.4558	0.7081	2.0559	0.0398*	H_0 is rejected

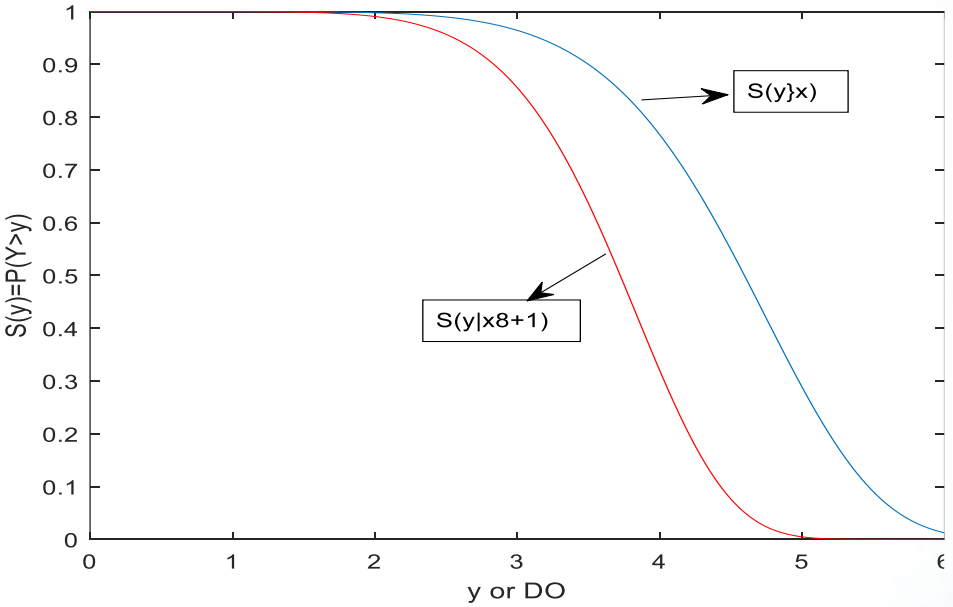
*) : significant with significant level 5%

Interpretation of the obtained WR model

The affected Covariate	$R\_S(y\|\mathbf{x})$	$R\_F(y\|\mathbf{x})$	$R\_h(y\|\mathbf{x})$	$R\_\mu(y\|\mathbf{x})$
X2 (Total of Dissolved Solid or TDS)	0.9953	1.0032	1.0051	0.9993
X4 (Temperature)	0.7390	1.1991	1.3519	0.9573
X8 (Total of Ferro Concentration)	0.1949	2.0257	4.2880	0.8102

Interpretation :
The increasing of TDS, water temperature, concentration of ferro can increase the probabilit y of the polluted Mahakam River water; can inc rease the rate of the polluted Mahakam River water, and can decrease of DO.





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