Geostatistics in the SPRING Exercise 2

Course: Master of Science on Geospatial Technologies Professor: Carlos A. Felgueiras

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3 Modeling spatial variable considering isotropic behavior

3.1 Performing exploratory analysis in the original samples

• Select, in the **Control Pan**el, the InfoLayer (IL) *pts_originais* of the category *Altimetria*.

• In the **Análysis menu** of the SPRING choose the **Geoestatístics** option and, following, choose the **Exploratory Analysis** option.

🖩 Análise Exploratór 📃 🗖 🔀		
Estat ística		
Estat ísticas Descritivas		
Plano de Informação		
Ativo: pts_originais		
Selecionar outro PI		
Executar Fechar Ajuda		

- o Generating the report of statistic summaries for the pts_originais data
 - Select the **option**: *Descriptive Statistics*.
 - Click on the Apply button.

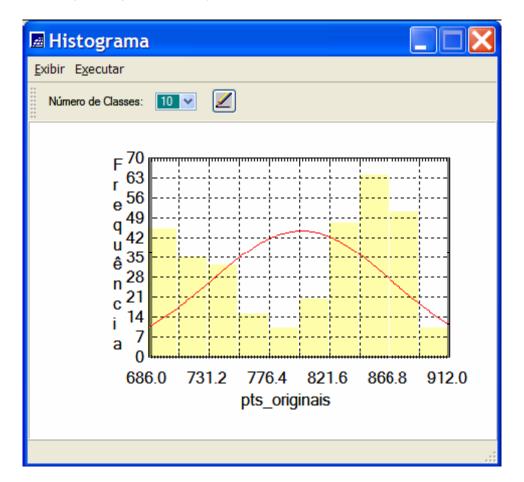
• The figure below shows the *report of the statistic summaries* calculated for the InfoLayer pts_originais.

🖩 Relatório de Dados 🛛 📃 🗖 🔀
E S T A T Í S T I C A S: pts_originais => Número de Pontos 329 => Nédia 800.93617021 => Varância 4499.03239992 => Desvio Padrão 67.07482687 -> Coeficiente de Variação 0.08374553 => Coeficiente de Assimetria -0.31103847 => Coeficiente de Curtose 1.55911308 => Valor Mínimo 688.00000000 => Quartil Inferior 733.0000000 => Quartil Superior 860.0000000 => Valor Máximo 911.00000000
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Apagar Fechar Ajuda

- o Visulising the data Histogram
 - In the same Exploratory Analysis window select the option Histogram
 - Click on the Apply button

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Histograma 💌		
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Ativo: pts_originais		
Selecionar outro PI		
Executar Fechar Ajuda		

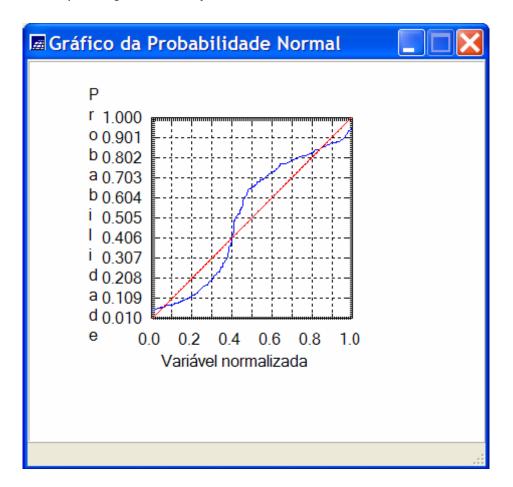
• The figure below shows the *histogram graph* for the data of the pts_originais InfoLayer



- o Visualizing the Normal Probability Graph
 - In the same Exploratory Analysis window select the **option** *Normal Probability Plot.*
 - Click on the Apply button.

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Estat ística		
Gráfico de Probabilidade Normal		
Plano de Informação		
Ativo: pts_originais		
Executar Fechar Ajuda		

• The figure below shows the *Normal Probability graph* for the data of the pts_originais InfoLayer



3.2 Performing exploratory analysis in the without tendency point samples

• Select, in the Control Panel, the InfoLayer (IL) *pts_semtendencias* of the category *Altimetria*.

• In the Analysis **menu** of the SPRING choose the Geoestatistics **option** and, following, choose the *Exploratory Analysis* **option**.

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Estat ísticas Descritivas 💌		
Plano de Informação		
<u>Ativo:</u> pts_semtendencias		
Selecionar outro PI		
Executar Fechar Ajuda		

- o Generating the report of statistic summaries for the pts_semtendencias data
 - Select the option: *Descriptive Statistics*.
 - Click on the Apply button.

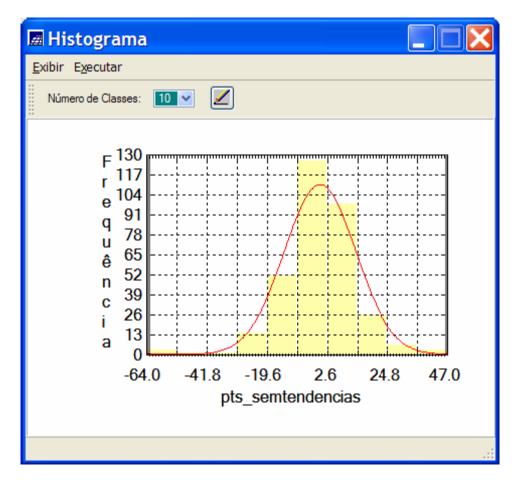
• The figure below shows the *report of the statistic summaries* calculated for the InfoLayer pts_semtendencias

🖩 Relatório de Dados 🛛 📃 🗖 🔀	
E S T A T Í S T I C A S: pts_semtendencias => Número de Pontos 329 => Nédia -0.10882524 => Variância 174.24046295 => Desvio Padrão 13.20001754 => Coeficiente de Variação -121.29555218 => Coeficiente de Assimetria -0.71681917 => Coeficiente de Curtose -6.80759730 => Valor Mínimo -62.5000000 => Quartil Inferior 7.46670008 => Valor Máximo 45.81819916	
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Apagar Fechar Ajuda	.:

- o Visualizing the Histogram of the data
 - In the same Exploratory Analysis window select the **option**: *Histogram*.
 - Click on the Apply button.

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Histograma 💌		
Plano de Informação		
<u>Ativo: pts_semtendencias</u>		
Selecionar outro PI		
Executar Fechar Ajuda		

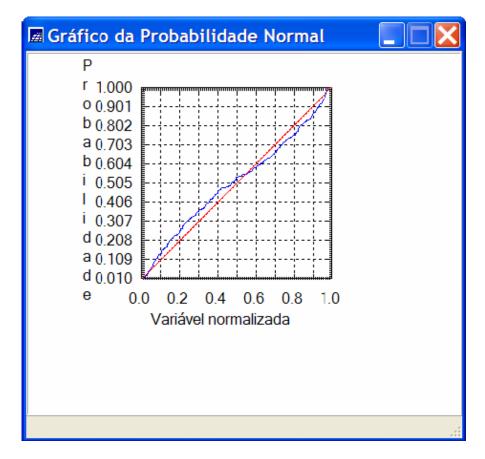
• The figure below shows the *histogram graph* of the data in the InfoLayer pts_semtendencias.



- o Visualizing the Normal Probability Graph
 - In the same Exploratory Analysis window select the **option** *Normal Probability Plot.*
 - Click on the *Apply* **button**.

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Estat ística Gráfico de Probabilidade Normal			
Plano de Informação Ativo: pts_semtendencias			
Selecionar outro PI			
Executar Fecha ⁻ Ajuda			

• The figure below shows the *Normal Probability graph* for the data of the pts_semtendencias InfoLayer



IMPORTANT: PERFORM A COMPARATIVE ANALYSIS FOR THE TWO EXPLORATORY ANALYSIS WITH INFOLAYERS: pts_originais e pts_semtendencias

3.3 Generating omnidirectional experimental semivariograms for the original points

 Select, in the Control Panel, the InfoLayer *pts_originais* of the category *Altimetria*.

• In the *Analysis* **menu** of the SPRING select the **option** *Geoestatistics* and, following, select the **option** *Semivariograma Generation...*

o Visualizing the experimental semivariogram taken from the original data.

- In the window Semivariogram Generation select the **option** *Unidirectional* as the **Analysis**:
- Select the option Irregular for the Sample field
- Select the option Semivariogram for the Options field
- · Create the unidirectional semivariogram setting, in this window, the

following distance and direction parameters: Number of lags (No lags) equal

9, Spatial **Increment** equal *860*, Spatial **Tolerance** equal *430*, Angular Direction **(Dir1:**) equal *0* degrees, Angular Tolerance (**Tol1:**) equal *90*

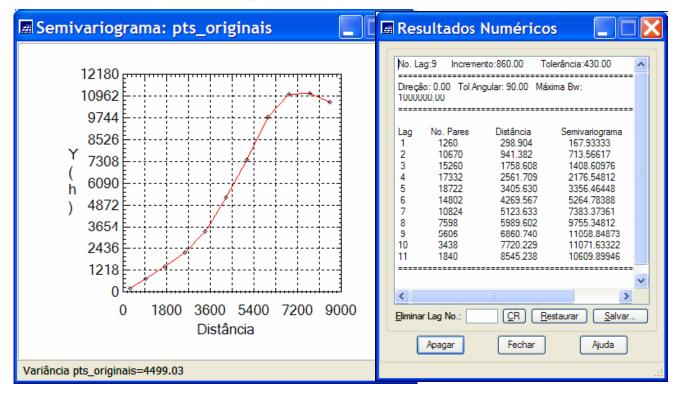
degrees and Bandwidth (Bw1:) equal Max.

🖩 Geração de Semivariograma 🛛 🔲 🔀				
PI Ativo: pts_originais				
Análise: Unidirecional V Amostragem: Inegular V				
Opcões: Semivariograma				
Opções: Semivariograma				
Parâmetros de Lag				
No. Lag: Incremento: Tolerância:				
9 (+) (±) (±) (430.000000 (+) (+) (+) (+) (+) (+) (+) (+) (+) (+)				
Parametros de Direção				
Dir1: 0.000000 + Tol1: 90.00000 + Ew1: MAX +				
2 Dir2: 45.0000(+ Tol2: 35.0000(+ Ew2: MAX +				
3 Dir3: 90.0000(+ Tol3: 35.0000(+ Ew3: MAX +				
4 Dir4: 135.0000 + Tol4: 35.00000 + Ew4: MAX +				
Padronizar Resultado Numérico				
Executar Fechar Ajuda				

• Click on the *Apply* **button** to show the semivariogram graph generated from the given parameters. Change the current distance and directions parameters in order to create new semivariograms better the already created. Use qualitative visual criteria to compare the variograms.

• Observation: Click on the **button** *Numeric Result...* to display a numeric report related to the experimental semivariogram values (*lag, No. pairs, distance and* $\gamma(h)$). In this window pay attention mainly to the $\gamma(h)$ values obtained with few pair of points.

• The figures below shows the semivariogram graph and numerical results created from the user defined parameters.



• Important: Perform visual and quantitative analysis in the above semivariogram.

What is approximately its sill value? Compare this sill value with the global variance value of the data. Observe the nugget and range values. Compare the value of the range with the length of the region we are studing (7km x 10km). What is your opinion about the range value of the above semivariogram?

3.4 Generating omnidirectional experimental semivariograms for the points with no tendencies

• Select, in the Control Panel, the InfoLayer *pts_semtendencias* of the category *Altimetria*.

• In the *Analysis* **menu** of the SPRING select the **option** *Geoestatistics* and, following, select the **option** *Semivariograma Generation...*

o Visualizing the experimental semivariogram taken from the original data.

- In the window Semivariogram Generation select the **option** *Unidirectional* as the **Analysis**:
- Select the option Irregular for the Sample field
- Select the option Semivariogram for the Options field
- · Create the unidirectional semivariogram setting, in this window, the

following distance and direction parameters: Number of lags (No lags) equal

7, Spatial Increment equal 500, Spatial Tolerance equal 250, Angular

Direction (Dir1:) equal *O* degrees, Angular Tolerance (Tol1:) equal *90*

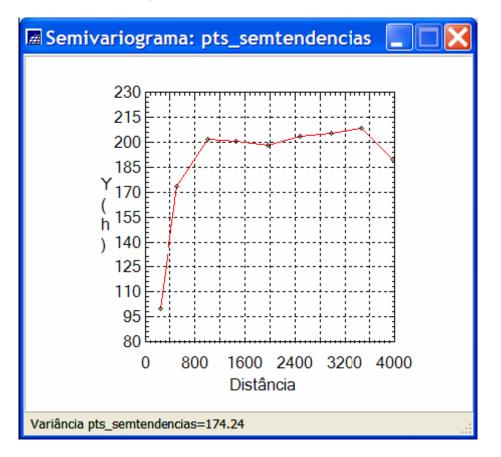
degrees and Bandwidth (Bw1:) equal Max.

🖩 Geração de Semivariograma 🛛 🔲 🔀				
PI Ativo: pts_semtendencias				
Análise: Unidirecional V Amostragem: Irregular V				
Opções: Semivariograma				
PI de Cruzamento Corte:				
Parâmetros de Lag				
No. Lag: Incremento: Tolerância:				
7 (+) 500.000000 (+) 250.000000 (+)				
Parametros de Direcão				
✓ Dir1: 0.000000 (+) Tol1: 90.00000 (+) Bw1: MAX +)				
□ 2 Dir2: 45.0000(+ Tol2: 35.0000(+ Bw2: MAX +				
3 Dir3: 90.00000 + Tol3: 35.00000 + Bw3: MAX +				
4 Dir4: 135.0000 + Tol4: 35.00000 + Bw4: MAX +				
Padronizar Resultado Nurrérico				
Executar Fechar Ajuda				

• Click on the *Apply* **button** to show the semivariogram graph generated from the given parameters. Change the current distance and directions parameters in order to create new semivariograms better the already created. Use qualitative visual criteria to compare the variograms.

• Observation: Click on the **button** *Numeric Result...* to display a numeric report related to the experimental semivariogram values (*lag, No. pairs, distance and* $\gamma(h)$). In this window pay attention mainly to the $\gamma(h)$ values obtained with few pair of points.

• The figures below shows the semivariogram graph and numerical results created from the user defined parameters.



• Important: Perform visual and quantitative analysis in the above semivariogram. What is approximately its sill value? Compare this sill value with the global variance value of the data. Observe the nugget and range values. Compare the value of the range with the length of the region we are studing (7km x 10km). What is your opinion about the range value of the above semivariogram? 3.5 Fitting theoretical semivariograms into the experimental ones

• Select, in the Control Panel, the IL *pts_semtendencias* of the category *Altimetria*.

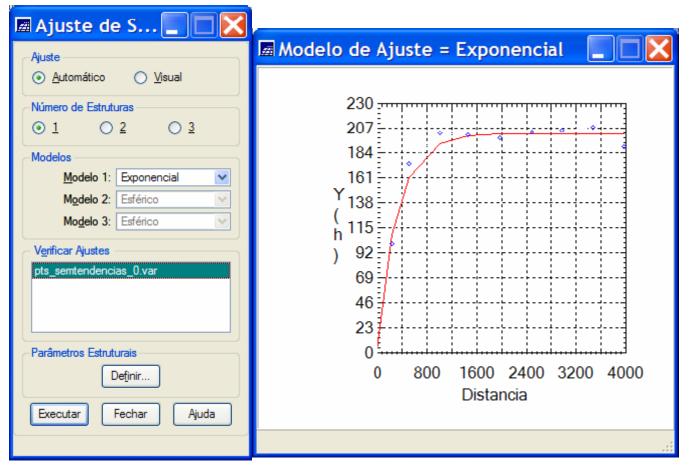
• In the *Analysis* **menu** of the SPRING select the **option** *Geoestatistics* and, following, select the **option** *Semivariogram Modeling*

• Visualizing Fitted Semivariogramas for the data of the pts_semtendencias Info Layer.

- Select Automatic as the Adjust option in the Semivariogram Modeling window
- In this same window select **Number of Structures** equal *1* and *Exponential* for the

Model option.

- Click on the **button** Apply.
- Click on the semivariogram name that appears in the Adjust Verification list to show the graph of the fitted semivariogram got with the defined model parameters.
- Change the parameter values to obtain different theoretical semivariograms until you find a satisfactory result. Perform qualitative analysis (visual) and quantitative analysis using the data report presented along with the fitted semivariograma graph.



• Click on the *Define...* **button** in the Semivariogram Modeling window to open a new window where the user will store the final parameters of the semivariograma model.

• The Nugget Efect, Contribution and Range parameters are reported in the last line (see

🖉 Parâmetros Estrut...

highlighted line below) of the values presented in the Data Report window

presented in the Data Report window.	- Parâmetros
🖾 Relatório de Dados 📃 🗖 🗙	Número de Estruturas: 1 2 3
AJUSTE DO SEMIVARIOGRAMA	Efeito Pepita: 2.306
Sumário: Arquivo: C:	Primeira Estrutura
\springdb\Geoestatistica\SaoCarlos/Canchim/GeoStatistic/pts_semtendencias_0.var No. de variáveis: 3	Tipo: Exponencial V Contribuição: 198.836 Ângulo Anis.: 0
No. de Lags: 9 No. de Lags usados: 9	Contribuição: 198.836 Ångulo Anis.: 0 Alcance Máx.: 980,749 Alcance Mín.: 980,749
Parâmetros iniciais: Efeito Pepita (Co): 30.482	Segunda Estrutura
Para modelo transitivo : Exponencial Contribuição (C1): 170.341 Alcance (a): 1987.256	Tipo: Esférico
	Contribuição: Ângulo Anis.:
Modelo de Semivariograma Exponencial No. Akaike Efeito Pepita Contribuição Alcance	Alcance Máx.: Alcance Mín.:
1 -47.096 30.482 170.341 1987.256	Terceira Estrutura
2 -48.488 20.329 175.170 546.827 3 -64.596 2.306 198.836 980.749	Tipo: Esférico
	Contribuição: Ângulo Anis.:
<u>S</u> alvar	Alcance Máx.: Alcance Mín.:
Apagar Fechar Ajuda	Executar Fechar Ajuda

• The Structural Parameters window must be filled out with:

Number of Structures equal 1

- Nugget Effect igual to 2.306
- For the first structure fields, because we have only one structure,:

Choose *Exponential* as the Structure **Type**.

Fill out the Contribution field with the value 198.836

Fill out the Anis. Angle (anisotropy angle) field with the value O.

Fill out the Max Range (maximum range) field with the value 980.749.

Fill out the Min Range (minimum range) field with the value 980.749.

• Click on the Apply button of the window Structural Parameters in order to store the above information related to the theorectical (modeled) semivariogram.

IMPORTANT: To define a semivariograma to the IL pts_originais repeat the sections 3.4 and 3.5 selecting the pts_originais in the Control Panel.or you can use the same variogram model you got for the pts_semtendencia. What do you think about this?