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Referência bibliografica

ACERBI, C.; TASCHE, D. On the coherence of expected shortfall. **Journal of Banking & Finance**, Elsevier. v. 26, n. 7, p. 1487–1503, 2002.

AMARANTE, O. A.; BROWER, M.; ZACK, J.; EOLICA, C. S. E. Atlas do potencial eólico brasileiro. **Atlas do potencial eolico brasileiro**, Ministerio de Minas e Energia Eletrobras. 2001.

AMJADY, N.; KEYNIA, F.; ZAREIPOUR, H. Short-term wind power forecasting using ridgelet neural network. **Electric Power Systems Research**, v. 81, n. 12, p. 2099–2107, 2011. Elsevier.

BARTHELMIE, R. J.; MURRAY, F.; PRYOR, S. C. The economic benefit of short-term forecasting for wind energy in the UK electricity market. **Energy Policy**, Elsevier. v. 36, n. 5, p. 1687–1696, 2008. Disponível em: <http://www.sciencedirect.com/science/article/pii/S0301421508000323>.

BISGAARD, S.; KULAHCI, M. **Time series analysis and forecasting by example**. John Wiley & Sons, 2011.

BOLLERSLEV, T. Generalized autoregressive conditional heteroskedasticity. **Journal of econometrics**, Elsevier. v. 31, n. 3, p. 307–327, 1986.

BOX, G. E. P.; JENKINS, G. M. Time series analysis: forecasting and control. **Francisco Holden-Day**, 1976.

BOYD, S.; VANDENBERGHE, L. **Convex Optimization**. Cambridge University Press, 2004.

CCEE. **Câmara de Comercialização de Energia Elétrica.** Brasil. 2010.

CCEE. **Câmara de Comercialização de Energia Elétrica**. Disponível em: <http://www.ccee.org.br/portal/faces/pages_publico/quem-somos/razao-de-ser>. Acesso em: 19/2/2015.

CONEJO, A. J.; CASTILLO, E.; MINGUEZ, R.; GARCIA-BERTRAND, R. **Decomposition techniques in mathematical programming: engineering and science applications**. Springer Science & Business Media, 2006.

COSTA, A. *et al.* A review on the young history of the wind power short-term prediction. **Renewable and Sustainable Energy Reviews**, Elsevier. v. 12, n. 6, p. 1725–1744, 2008.

COUNCIL, G. W. E. Global wind statistics 2011. **GWEC Report**, 2012.

DAMODARAN, A. Disponível em: <http://pages.stern.nyu.edu/~adamodar/>. Acesso em: 20/2/2015.

DONGMEI, Z.; YUCHEN, Z.; XU, Z. Research on wind power forecasting in wind farms. Power Engineering and Automation Conference (PEAM), 2011 IEEE. **Anais...** . v. 1, p.175–178, 2011.

FOCKEN, U.; LANGE, M. **Physical approach to short-term wind power prediction**. Springer, 2006.

FOLEY, A. M.; LEAHY, P. G.; MARVUGLIA, A.; MCKEOGH, E. J. **Current methods and advances in forecasting of wind power generation**. Renewable Energy, Elsevier. v. 37, n. 1, p. 1–8, 2012.

GALVÃO, E. Q. Disponível em: <http://qgenergia.com/br/destaques/ler/complexo-eolico-de-amontada-inicia-geracao-de-energia-por-fonte-limpa-e-renovavel/MzI=>. Acesso em: 20/2/2015.

GOMES, L. L.; BRANDÃO, L. E.; PINTO, A. C. F. Otimização de Carteiras de Contratos de Energia Elétrica através da Medida Ômega. **RBFin - Revista Brasileira de Finanças**, v. 8, n. 1, p. 45–67, 2010.

HIBON, M.; EVGENIOU, T. To combine or not to combine: selecting among forecasts and their combinations. **International Journal of Forecasting**, v. 21, n. 1, p. 15–24, 2005. Elsevier.

HONG, Y.-Y.; CHANG, H.-L.; CHIU, C.-S. Hour-ahead wind power and speed forecasting using simultaneous perturbation stochastic approximation (SPSA) algorithm and neural network with fuzzy inputs. **Energy**, Elsevier. v. 35, n. 9, p. 3870–3876, 2010.

HORTA, P. CMVM. Disponível em: <http://www.cmvm.pt/CMVM/Publicacoes/Cadernos/Documents/6d2b142151b649888ef0159b578126ebCalculeoRiscodasuaCarteira.pdf>. Acesso em: 20/2/2015.

JUNG, J.; BROADWATER, R. P. Current status and future advances for wind speed and power forecasting. **Renewable and Sustainable Energy Reviews**, v. 31, p. 762–777, 2014. Elsevier. Disponível em: <http://www.sciencedirect.com/science/article/pii/S1364032114000094>.

KARINIOTAKIS, G. *et al.* The state of the art in short-term prediction of wind power-from an offshore perspective. Proceedings of. **Anais...** . p. 20–21, 2004.

KITAJIMA, T.; YASUNO, T. Output prediction of wind power generation system using complex-valued neural network. **SICE Annual Conference 2010.**

LEI, M. *et al.* A review on the forecasting of wind speed and generated power. **Renewable and Sustainable Energy Reviews**, Elsevier. v. 13, n. 4, p. 915–920, 2009.

LEITE, A. D. **A Energia do Brasil**. Elsevier, 2007.

LV, P.; YUE, L. Short-term wind speed forecasting based on non-stationary time series analysis and ARCH model. Multimedia Technology (ICMT), 2011 International Conference on. **Anais...** . IEEE. p. 2549–2553, 2011.

MILLIGAN, M.; MILLER, A.; CHAPMAN, F. **Estimating the Economic Value of Wind Forecasting to Utilities**. 1995.

MONTEZANO, B. **As energias solar e eólica no Brasil**. Disponível em: <http://www.cresesb.cepel.br/download/casasolar/casasolar2013.pdf>. Acesso em: 19/2/2015.

PINHO, J. T. *et al.* Sistemas híbridos. **Soluções energéticas para a Amazônia**, Brasília: Ministério de Minas e Energia. 2008.

PINTO, M. O. **Fundamentos de Energia Eólica**. LTC – Livros Técnicos e Científicos Editora Ltda., 2012.

ROCKAFELLAR, R. T.; URYASEV, S. Optimization of conditional value-at-risk. **The Journal of Risk**, v. 2, n. 3, p. 21–41, 2000.

SALAHI, M.; MEHRDOUST, F.; PIRI, F. CVaR Robust Mean-CVaR Portfolio Optimization. **ISRN Applied Mathematics**, v. 2013, 2013. Hindawi Publishing Corporation.

SEMACE. Disponível em: <http://www.semace.ce.gov.br/2012/06/complexo-eolico-amontada/>. Acesso em: 20/2/2014.

SIDERATOS, G.; HATZIARGYRIOU, N. D. An advanced statistical method for wind power forecasting. **Power Systems, IEEE Transactions on**, IEEE. v. 22, n. 1, p. 258–265, 2007.

TASCIKARAOGLU, A.; UZUNOGLU, M. A review of combined approaches for prediction of short-term wind speed and power. **Renewable and Sustainable Energy Reviews**, v. 34, p. 243–254, 2014. Elsevier. Disponível em: <http://www.sciencedirect.com/science/article/pii/S1364032114001944>. .

TIMPONI, R. R. **Leilões como Mecanismo de Planejamento da Expansão de Geração Elétrica:** o caso do Setor Elétrico Brasileiro, Universidade Federal do Rio de Janeiro. 2010.

WANG, M.-D.; QIU, Q.-R.; CUI, B.-W. Short-term wind speed forecasting combined time series method and arch model. Machine Learning and Cybernetics (ICMLC), 2012 International Conference on. **Anais... ,** IEEE. v. 3, p.924–927, 2012.

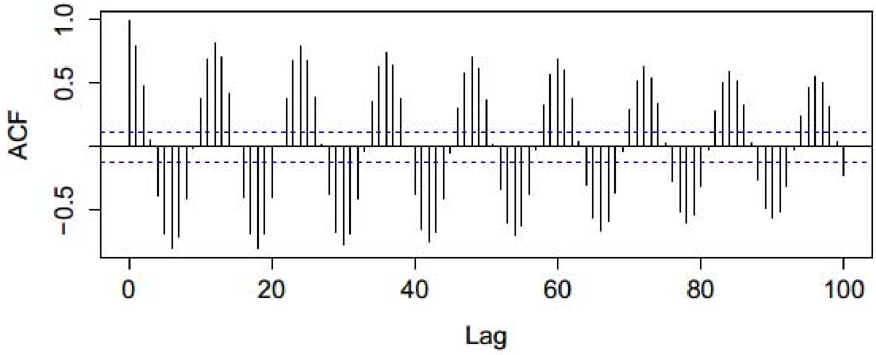
XIONG, J. X.; IDZOREK, T. M. The impact of skewness and fat tails on the asset allocation decision. **Financial Analysts Journal**, CFA Institute. v. 67, n. 2, p. 23–35, 2011.

ZHANG, X.; ZHANG, J.; LI, Y.; ZHANG, R. Short-term forecasting of wind speed based on recursive least squares. 2011 International Conference on Electrical and Control Engineering. **Anais...** . IEEE. p. 367–370, 2011.

Apêndice

```
using JuMP
using MathProgBase
using Gurobi
using Distributions
using DataFrames

objetivo=Float64[]
resultQt=Float64[]
resultz=Float64[]
result50=Float64[]
resultmean=Float64[]
resultPc= Float64[]
resultQc= Float64[]
resultPt= Float64[]

srand(1) #fixa um seed para a simulação

for i in 1:5

  pld = readtable("C:/Users/YourPathHere/pld.csv",separator=';',
header=true)
  pot = readtable("C:/Users/ YourPathHere/simulacaopotj.csv",
separator=';', header=true)

  S=1000 #número de cenários

  pot1=Float64[pot[i,j] for j in 1:S]
  pld1=Float64[pld[j,i] for j in 1:S]

  G=28*pot1*24*30 #potência gerada pelas 28 torres

  Pt=mean(pld1)*rand(Uniform(0.8,1.2),1)[1] #preço a termo utilizado

  Pc=mean(pld1)*rand(Uniform(0.6,1.5),1)[1]  #preço do mwm no contrato

  #Energia contratada
  Qc=mean(G)
  cvar=0
  alpha=0.05
  m=Model(solver=GurobiSolver())
  @defVar(m,Qt)
  @defVar(m,delta[1:S]>=0)
  @defVar(m,R[1:S])
  @defVar(m,z)
  @setObjective(m,Max,(1/S)*sum{R[s],s=1:S})
  @addConstraints(m,begin
                    sum_to_one[s=1:S], Pc*Qc-Pt*Qt+pld1[s]*(Qt+G[s]-
Qc)==R[s]
                  end)
  @addConstraint(m,z-(1/(S*alpha))*sum{delta[s], s=1:S}>=cvar)
  @addConstraints(m,begin
                    sum_to_one[s=1:S], delta[s]>=z-R[s]
                  end)

  status=solve(m)

  obj=getObjectiveValue(m)
  push!(objetivo, obj)
  result_Qt=getValue(Qt)
  push!(resultQt,result_Qt)
  result_z=getValue(z)
  push!(resultz,result_z)
  result_R=getValue(R)
  Result_R=Float64[result_R[i]for i in 1:S]
  result_50=sort(Result_R)[50]
  push!(result50,result_50)
  result_mean=mean(sort(Result_R)[1:50])
  push!(resultmean,result_mean)
  push!(resultPc,Pc)
  push!(resultQc,Qc)
  push!(resultPt,Pt)
end
```

Figura 5 – Implementação do modelo de otimização
Fonte: Própria



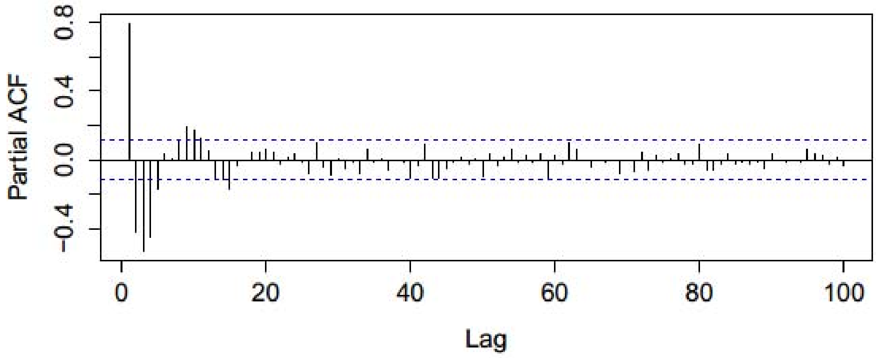


Gráfico 15 – FAC e FACP da série
Fonte: Própria

Coef	MW	m/s
Ar1	0.3843396	0.3676702
Ar2	0.2596147	0.28084
Intercept	0.9943759	2.8022087
Jan	-0.580416	-1.47092
Feb	-0.786458	-1.987754
Mar	-0.972694	-2.579939
Apr	-1.036036	-2.768226
May	-0.817925	-2.099441
Jun	-0.453858	-1.085876
Jul	-0.163394	-0.395277
Aug	0.3289415	0.7815713
Sep	0.5792598	1.4535935
Oct	0.5493253	1.4464359
Nov	0.3286412	0.8458

Tabela 7 – Coeficientes do modelo
Fonte: Própria

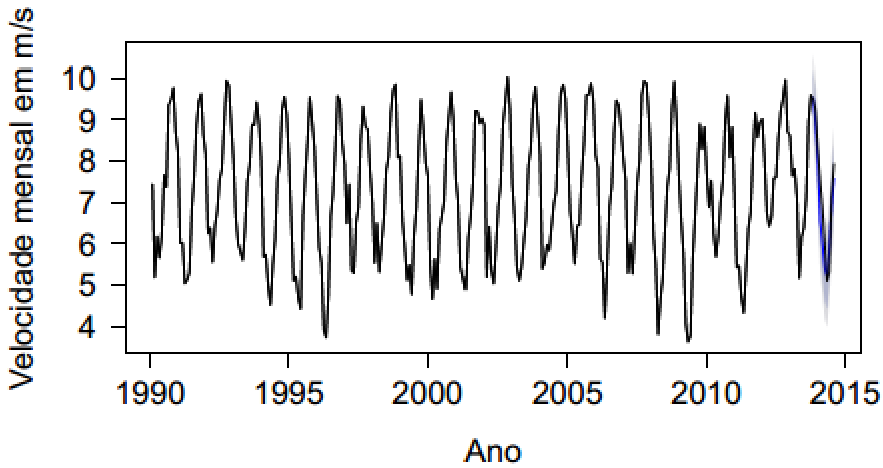


Gráfico 16 – Previsão de vento
Fonte: Própria

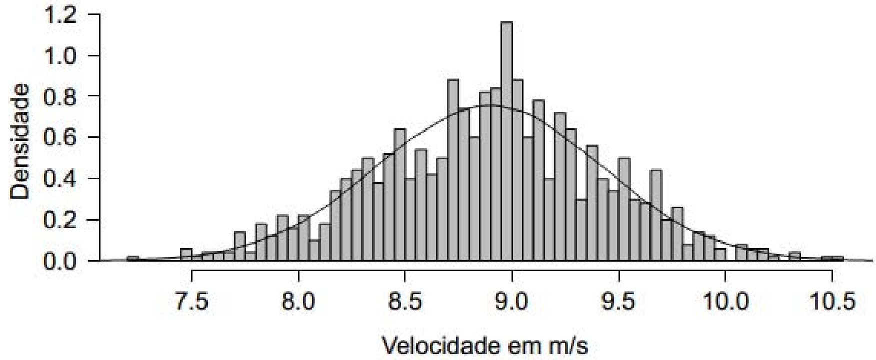


Gráfico 17 – Histograma de previsão de vento um período à frente
Fonte: Própria

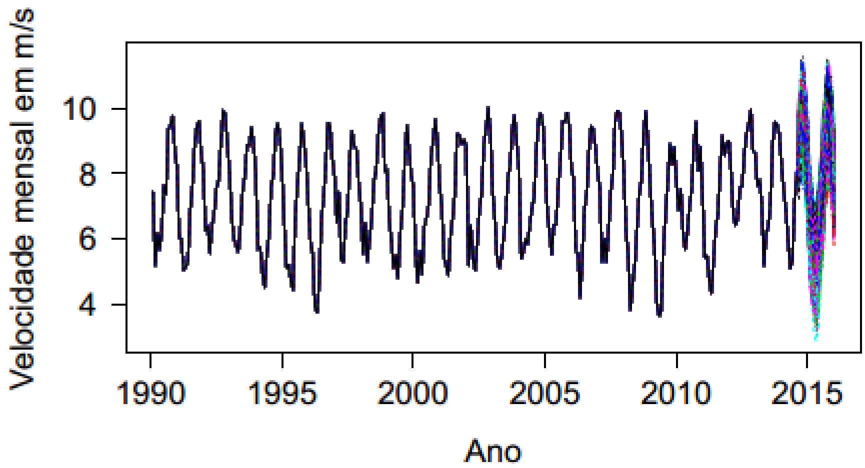


Gráfico 18 – Simulação velocidade de vento
Fonte: Própria

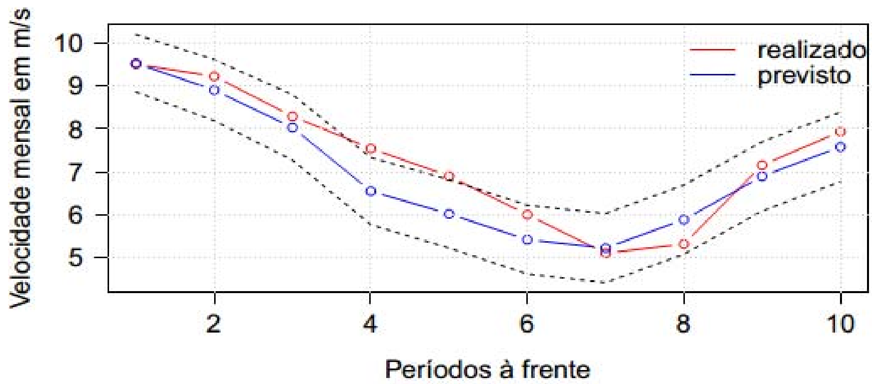


Gráfico 19 – Comparativo entre realizado e previsto - vento
Fonte: Própria