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Information Theory And Coding Formulas

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List of 15 Information Theory And Coding Formulas

Information Theory And Coding

Continuous Channels

1) Amount of Information

Open Calculator

fx $$I = \log 2\left(\frac{1}{P_k}\right)$$

ex $$2\text{bits} = \log 2\left(\frac{1}{0.25}\right)$$

2) Channel Capacity

Open Calculator

fx $$C = B \cdot \log 2(1 + SNR)$$

ex $$14.93388\text{b/s} = 3.4\text{Hz} \cdot \log 2(1 + 20\text{dB})$$

3) Data Transfer

Open Calculator

fx $$D = \frac{F_S \cdot 8}{T}$$

ex $$36.36364\text{s} = \frac{5\text{bits} \cdot 8}{1.1\text{b/s}}$$

4) Information Rate

Open Calculator

fx $$R = r_s \cdot H[S]$$

ex $$1800b/s = 1000b/s \cdot 1.8b/s$$

5) Maximum Entropy

Open Calculator

fx $$H[S]_{max} = \log 2(q)$$

ex $$4bits = \log 2(16)$$

6) Noise Power of Gaussian Channel

Open Calculator

fx $$N_o = 2 \cdot P_{SD} \cdot B$$

ex $$8.2E\hat{}22pW = 2 \cdot 1.2e10 \cdot 3.4Hz$$

7) Noise Power Spectral Density of Gaussian Channel

Open Calculator

fx $$P_{SD} = \frac{2 \cdot B}{N_o}$$

ex $$1.2E\hat{}10 = \frac{2 \cdot 3.4Hz}{578pW}$$

8) Nth Extension Entropy

Open Calculator

fx $$(H[S^n]) = n \cdot H[S]$$

ex $$12.6 = 7 \cdot 1.8b/s$$

9) Nyquist Rate

Open Calculator

fx $N_r = 2 \cdot B$

ex $6.8\text{Hz} = 2 \cdot 3.4\text{Hz}$

10) Symbol Rate

Open Calculator

fx $r_s = \frac{R}{H[S]}$

ex $1000\text{b/s} = \frac{1800\text{b/s}}{1.8\text{b/s}}$

Source Coding

11) Coding Efficiency

Open Calculator

fx $\eta_c = \left(\frac{H_r[S]}{L \cdot \log 2(D_s)}\right) \cdot 100$

ex $0.080991 = \left(\frac{1.13}{420 \cdot \log 2(10)}\right) \cdot 100$

12) Coding Redundancy

Open Calculator

fx $R_{\eta c} = \left(1 - \left(\frac{H_r[S]}{L \cdot \log 2(D_s)}\right)\right) \cdot 100$

ex $99.91901 = \left(1 - \left(\frac{1.13}{420 \cdot \log 2(10)}\right)\right) \cdot 100$

13) R-Ary Entropy

Open Calculator

fx $$(\mathrm{H_r[S]}) = \frac{\mathrm{H[S]}}{\log 2(\mathrm{r})}$$

ex $$1.135674 = \frac{1.8\mathrm{b/s}}{\log 2(3)}$$

14) Source Efficiency

Open Calculator

fx $$\eta_\mathrm{s} = \left(\frac{\mathrm{H[S]}}{\mathrm{H[S]_{max}}}\right) \cdot 100$$

ex $$45 = \left(\frac{1.8\mathrm{b/s}}{4\mathrm{bits}}\right) \cdot 100$$

15) Source Redundancy

Open Calculator

fx $$\mathrm{R_{\eta s}} = (1 - \eta) \cdot 100$$

ex $$30 = (1 - 0.7) \cdot 100$$

Variables Used

- **B** Channel Bandwidth *(Hertz)*
- **C** Channel Capacity *(Bit per Second)*
- **D** Data Transfer *(Second)*
- D_s Number of Symbols in Encoding Alphabet
- F_S File Size *(Bit)*
- $H_r[S]$ R-Ary Entropy
- $H[S^n]$ Nth Extension Entropy
- **H[S]** Entropy *(Bit per Second)*
- $H[S]_{max}$ Maximum Entropy *(Bit)*
- **I** Amount of Information *(Bit)*
- **L** Average Length
- **n** Nth Source
- N_o Noise Power of Gaussian Channel *(Picowatt)*
- N_r Nyquist Rate *(Hertz)*
- P_k Probability of Occurrence
- P_{SD} Noise Power Spectral Density
- **q** Total Symbol
- **r** Symbols
- **R** Information Rate *(Bit per Second)*
- r_s Symbol Rate *(Bit per Second)*
- $R_{\eta c}$ Code Redundancy
- $R_{\eta s}$ Source Redundancy

- **SNR** Signal to Noise Ratio *(Decibel)*
- **T** Transfer Speed *(Bit per Second)*
- η Efficiency
- η_c Code Efficiency
- η_s Source Efficiency

Constants, Functions, Measurements used

- Function: **log2**, log2(Number)
  Binary logarithm function (base 2)
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Power** in Picowatt (pW)
  Power Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Data Storage** in Bit (bits)
  Data Storage Unit Conversion
- Measurement: **Data Transfer** in Bit per Second (b/s)
  Data Transfer Unit Conversion
- Measurement: **Sound** in Decibel (dB)
  Sound Unit Conversion

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