Lorem Ipsum

14. Juni 2021

Teil I
Examples

1 Math

Consider the formula

$$p = (1 - \lambda) \cdot \lambda$$

but ignore it.

2 Images

Types can be inferred by a proof-like system with the following core rules:

$$\frac{}{\ldots, x : \tau, \ldots \vdash x :: \tau}\,\mathit{Var} \qquad \frac{\Gamma, x : \sigma \vdash t :: \tau}{\Gamma \vdash (\lambda x.\, t) :: \sigma \to \tau}\,\mathit{Abs} \qquad \frac{\Gamma \vdash t_1 :: \sigma \to \tau \qquad \Gamma \vdash t_2 :: \sigma}{\Gamma \vdash (t_1\ t_2) :: \tau}\,\mathit{App}$$

3 Lists

a) **Base Types**: Double, ...

b) **Compound Types:** Lists, Tuples, ...

c) **Type Classes**, have Instances, offer restricted form of polymorphism. Similar to Interfaces. E.g the type class `Eq` represents a set of Types.

d) **Algebraic Types**, similar to structs.

   - Enumeration Types
   - Product Types

4 Code

Multiline Code Example:

```
primes = sieve [2 ..]
sieve xs = head xs : sieve (dropMults (head xs)
                           (tail xs))
```

Code can be placed in line, e.g. `data Tree = Leaf Int | Node Tree Tree` with Verbatim.

5 Theorems and Co.

Def. (Probability Space)

blabla

Thm. (Total Probability & Bayes' Rule)

blabla

Lem. (Independance)

blabla

6 Boxes

Neyman-Pearson-Lemma:
Let $\Theta_0 = \{\vartheta_0\}$ and $\Theta_A = \{\vartheta_A\}$. Further let $T := R(X_1, \ldots, X_n; \vartheta_0, \vartheta_A)$ and $K := (c, \infty)$ as well as $\alpha^* := P_{\vartheta_0}[T \in K] = P_{\vartheta_0}[T > c]$.
$\Longrightarrow$ The Likelyhood-Ratio-Test with statistic T and rejection region K is *optimal* in the sense that: Every other test with significance level $\alpha \leq \alpha^*$ has a smaller power, i.e. a larger probability of type II error.

In general the hypothesises are not *simple*. The following quotient is usually a sensible test statistic in these cases:

The generalized Likelyhood-Ratio is given by

$$R(x_1, \ldots, x_n;) := \frac{\sup_{\vartheta \in \Theta_A} L(x_1, \ldots, x_n; \vartheta)}{\sup_{\vartheta \in \Theta_0} L(x_1, \ldots, x_n; \vartheta)}$$

z-Test, i.e. normal with known variance:
Assume $X_1, \ldots, X_n$ i.i.d. $\sim \mathcal{N}\left(\vartheta, \sigma^2\right)$

a) *Statistic Under* H_0:

$$T = \frac{\overline{X_n} - \mu_0}{\sigma / \sqrt{n}} \sim \mathcal{N}(0, 1)$$

b) *Rejection Region*:

   - $\vartheta_A > \vartheta_0$: $K = [z_{1-\alpha}, \infty)$
   - $\vartheta_A < \vartheta_0$: $K = (-\infty, z_\alpha]$
   - $\vartheta_A \neq \vartheta_0$: $K = (-\infty, z_{\frac{\alpha}{2}}] \cup [z_{1-\frac{\alpha}{2}}, \infty)$

where $\Phi^{-1}(\alpha) = z_\alpha$ and for convenience $z_{0.95} = 1.645$, $z_{0.975} = 1.960$.

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