EX1_Week4

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Ex1

Task a

a)

$P(y_1, ..., y_n, \theta, \alpha) = p(\alpha) \prod_{i=1}^{n} p(y_i|\theta)p(\theta_i|\alpha)$

Stan pseudo_code:

```
data {
  int <lower = 0> n;
  real y[n];
}

parameters {
  real alpha;
  real theta[n];
}

model{
  alpha ~ p()
  for (i in 1:n){
    theta[i] ~ p(alpha)
  }

  for (i in 1:n){
    y[i] ~ p(theta[i])
  }
}
```

b)

$P(y_1, ..., y_n, \theta, \mu, \alpha) = p(\alpha) \prod_{i=1}^{m} p(\mu_i|\alpha) \prod_{k=1}^{n} p(y_{i,k}|\theta_{i,k})p(\theta_{i,k}|\mu_i)$

Stan pseudo_code:

```
data {
  int <lower = 0> n;
  int <lower = 0> m;
```

```
  real y[m,n];
}

parameters {
  real alpha;
  real theta[m,n];
  real mu[m];
}

model{
  alpha ~ p()

  for (i in 1:m) {
    mu[i] ~ p(alpha)
  }

  for (i in 1:m){
    for (k in 1:n) {
     Theta[i,k] ~ mu[i]
    }
  }

  for (i in 1:m){
    for (k in 1:n) {
     y[i,k] ~ Theta[i,k]
    }
  }

}
```

c)

$P(y_1, ..., y_n, \mu, \alpha, \gamma) = p(\alpha)p(\gamma)\prod_{i=1}^{n} p(y_i|\mu_i, \sigma_i)p(\mu_i|x_i, \alpha)p(\sigma_i|x_i, \gamma)$

Stan pseudo_code:

```
data {
  int <lower = 0> n;
  real y[n];
  real x[n];
}

parameters {
  real alpha;
  real gamma;


  real mu[n];
  real sigma[n];
}

model{
  alpha ~ p()
```

```
  gamma ~ p()
  for (i in 1:n) {
    x[i] ~ p()
  }

  for (i in 1:n) {
    mu[i] ~ p(alpha) * p(x[i])
  }

  for (i in 1:n) {
    sigma[i] ~ p(gamma) * p(x[i])
  }
  for (i in 1:n){
     y[i] ~ p(sigma[i]) * p(mu[i])
  }

}
```

Task d

```
data {
  int <lower = 0> n;
  int <lower = 0> J;

  real y[n][J];
}

parameters {
  real mu0;
  real mu[n];
  real v1;
  real S12;
  real Phi;
  real v2
  real S22

  real sigma2[n];
}

model{

  mu0 ~ normal(0,10^3) #N(0, 10^6)

  v1 ~ p()
  v2 ~ p()
  S12 ~ p()
  S22 ~ p()
  phi ~ p(v1) * p(S12)

  for (i in 1:j ){
    sigma2[i] ~ p(v2) * p(S22)
```

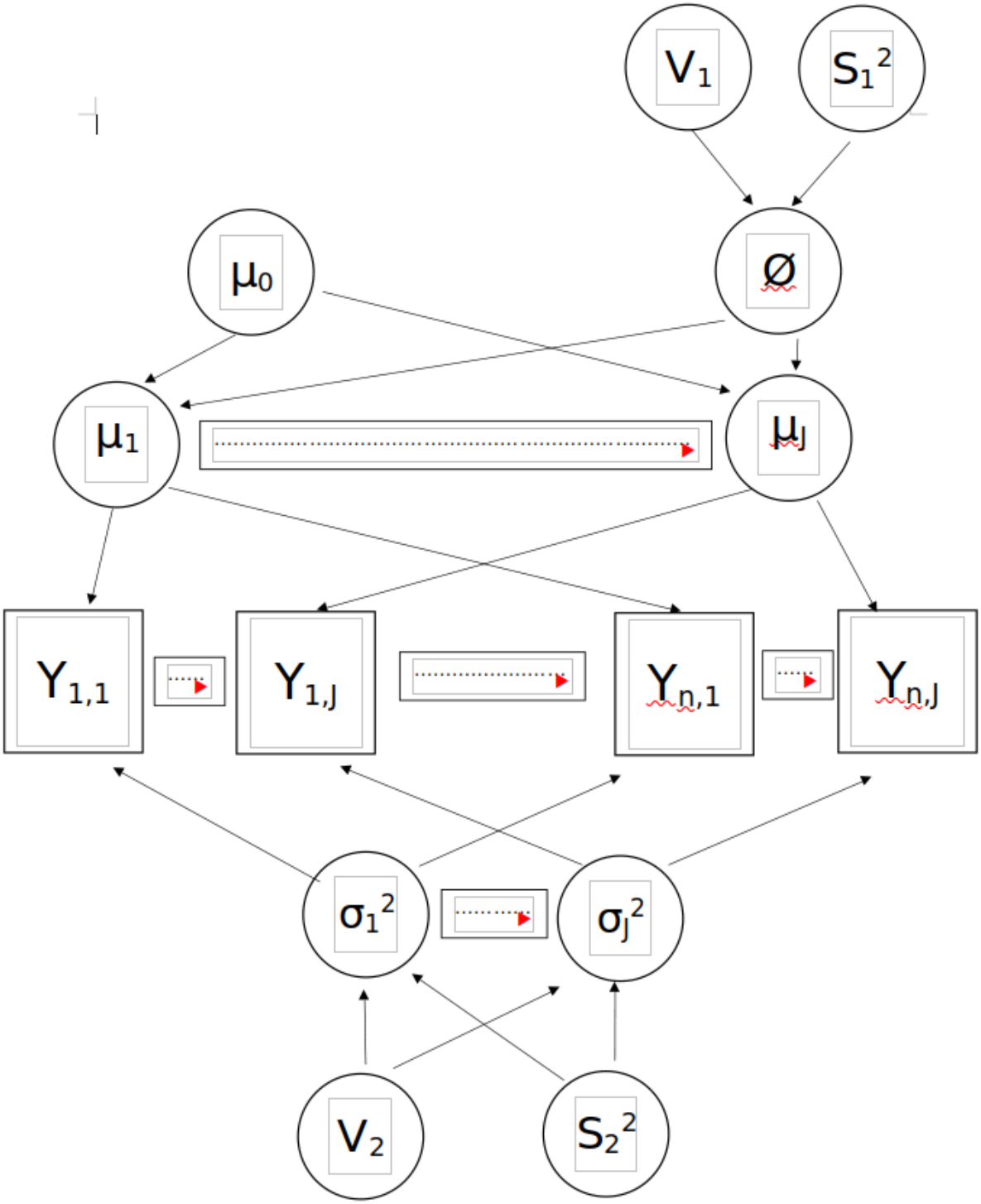

Figure 1: Schema

```
  }

  for (i in 1:n){
    for ( j in 1:J)
     y[i,j] ~ p(sigma[j]) * p(mu[j])
  }

}
```